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Sajedi

(10) **Patent No.: US 10,328,782 B2**
(45) **Date of Patent: Jun. 25, 2019**

(54) **AUTOMATIC VEHICLE COVER**

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(72) Inventor: **Majid Sajedi**, Shiraz (IR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 108 days.

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(22) Filed: **Feb. 24, 2017**

(65) **Prior Publication Data**

US 2017/0166041 A1 Jun. 15, 2017

Related U.S. Application Data

(60) Provisional application No. 62/299,561, filed on Feb. 25, 2016.

(51) **Int. Cl.**
B60J 11/04 (2006.01)

(52) **U.S. Cl.**
CPC ***B60J 11/04*** (2013.01); *B60Y 2400/405* (2013.01); *B60Y 2400/4045* (2013.01); *B60Y 2400/41* (2013.01); *B60Y 2410/10* (2013.01)

(58) **Field of Classification Search**
CPC ... B60J 11/00; B60J 11/04; B60J 11/06; B60J 11/08; B60J 11/02; B60J 7/1204; B60J 7/1252; B60J 7/1265
USPC 296/136.13, 136.12, 95.1, 107, 1, 108, 296/98, 100.04; 150/166, 167, 168
See application file for complete search history.

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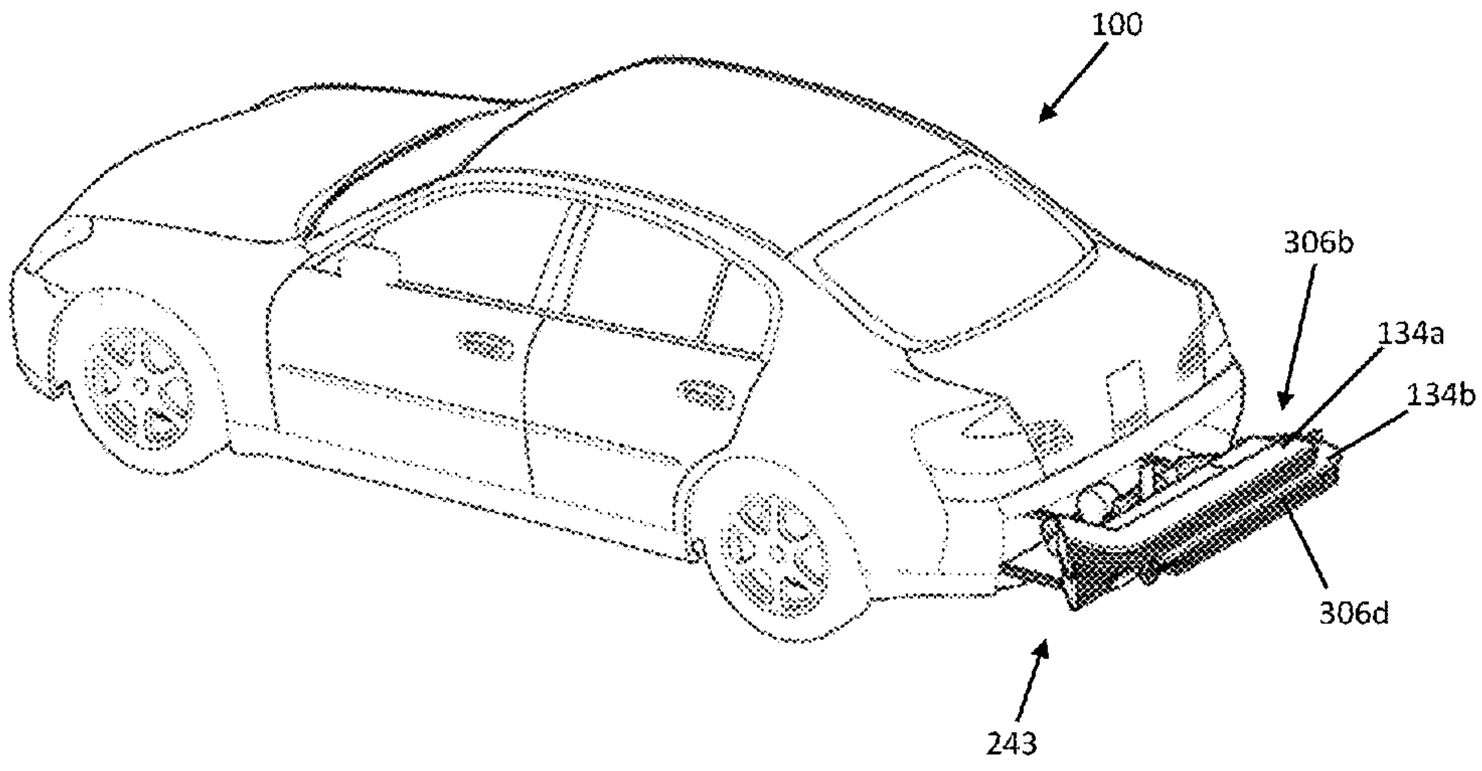
(74) *Attorney, Agent, or Firm* — Bajwa IP Law Firm; Haris Zaheer Bajwa

(57) **ABSTRACT**

A vehicle covering system that may include a cover having a first fold and a last fold, a first arm and a second arm, an arm (opening/closing) mechanism to open and close the first arm and the second arm, a folding mechanism to fold and unfold the cover; and a control system to cause the opening/closing mechanism to open the first arm and the second arm from a closed position to an opened position and cause the arm mechanism to close the first arm and the second arm from an opened position to a closed position, and cause the folding mechanism to fold and unfold the cover when the first and the second arms are in an opened position.

19 Claims, 28 Drawing Sheets



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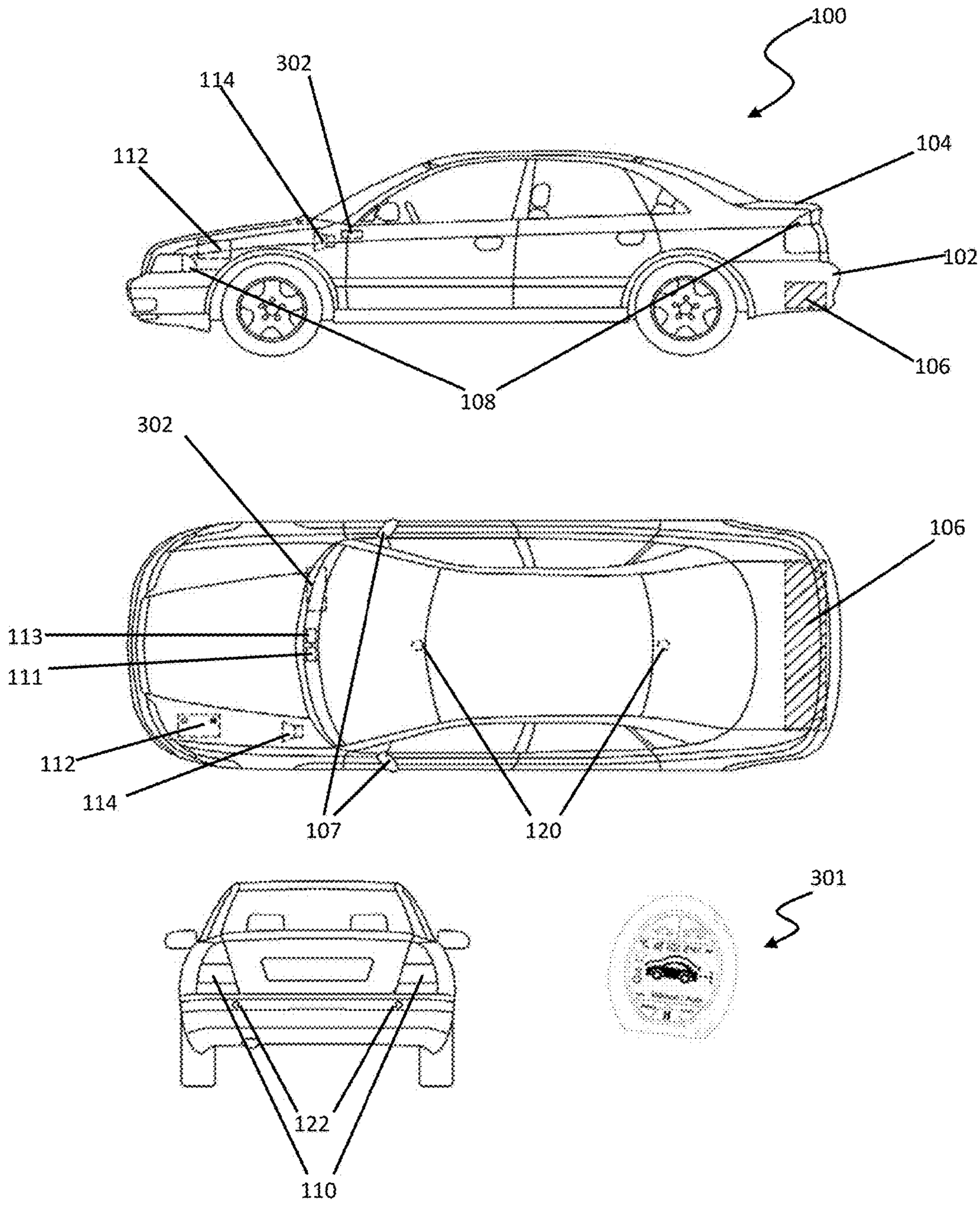
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301
122
110

FIG. 1

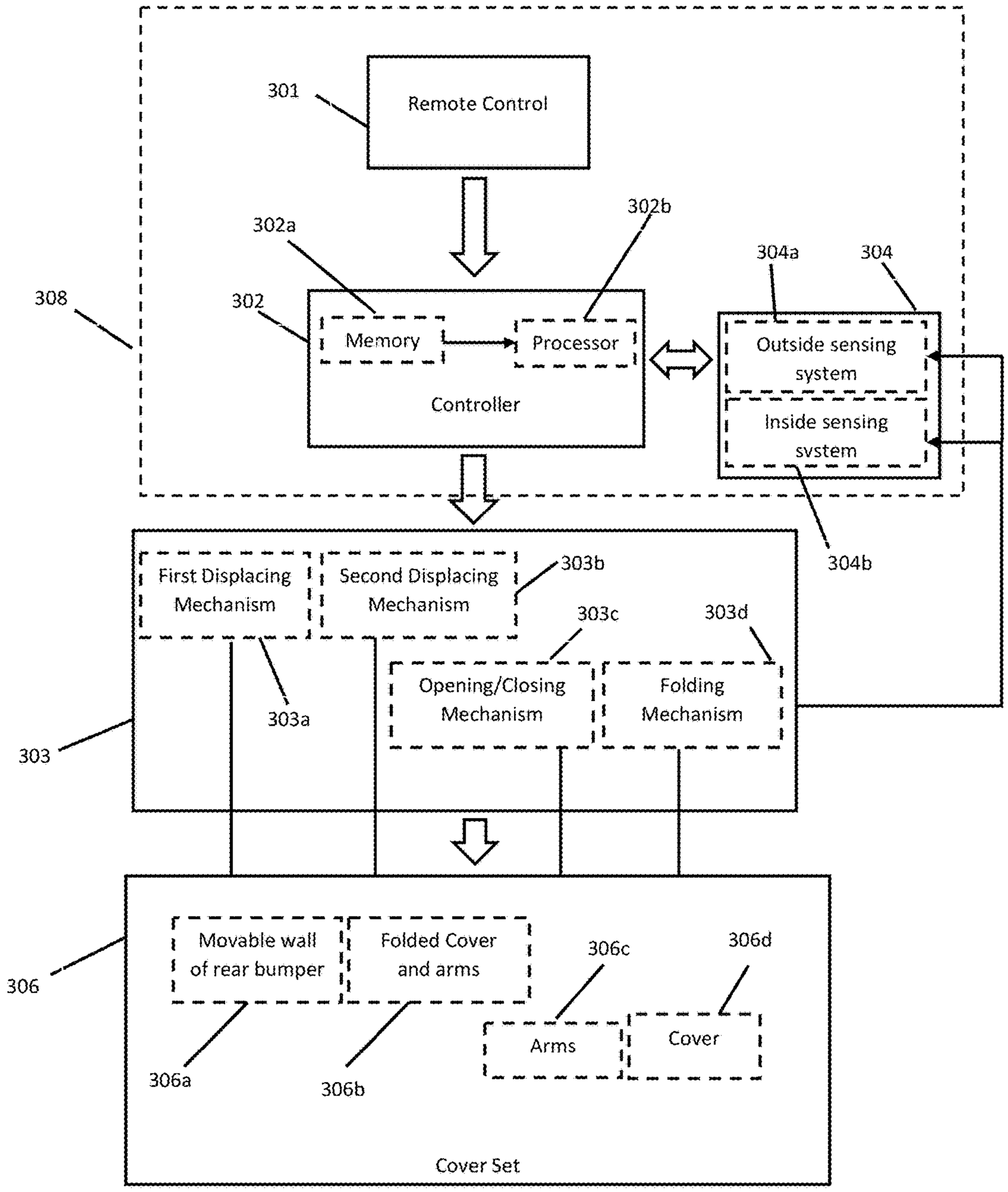
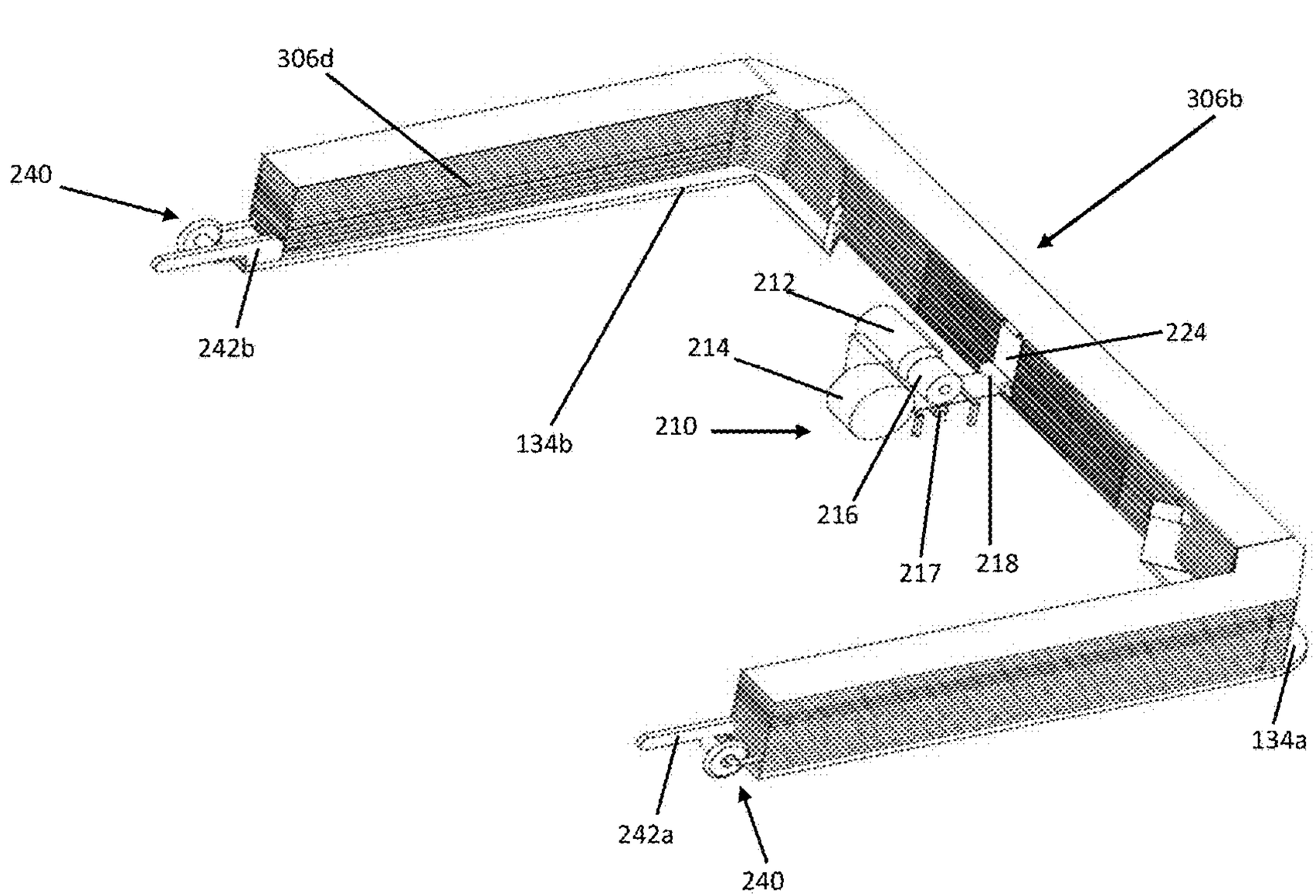

301
Remote Control
302a
302b
304a
304
308
302
Memory
Processor
Controller
Outside sensing system
Inside sensing system
304b
First Displacing Mechanism
Second Displacing Mechanism
303b
303c
303d
303a
Opening/Closing Mechanism
Folding Mechanism
303
306
Movable wall of rear bumper
Folded Cover and arms
306c
306d
Arms
Cover
306a
306b
Cover Set

FIG. 2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212
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217
218
134a
242a
240

FIG. 3A

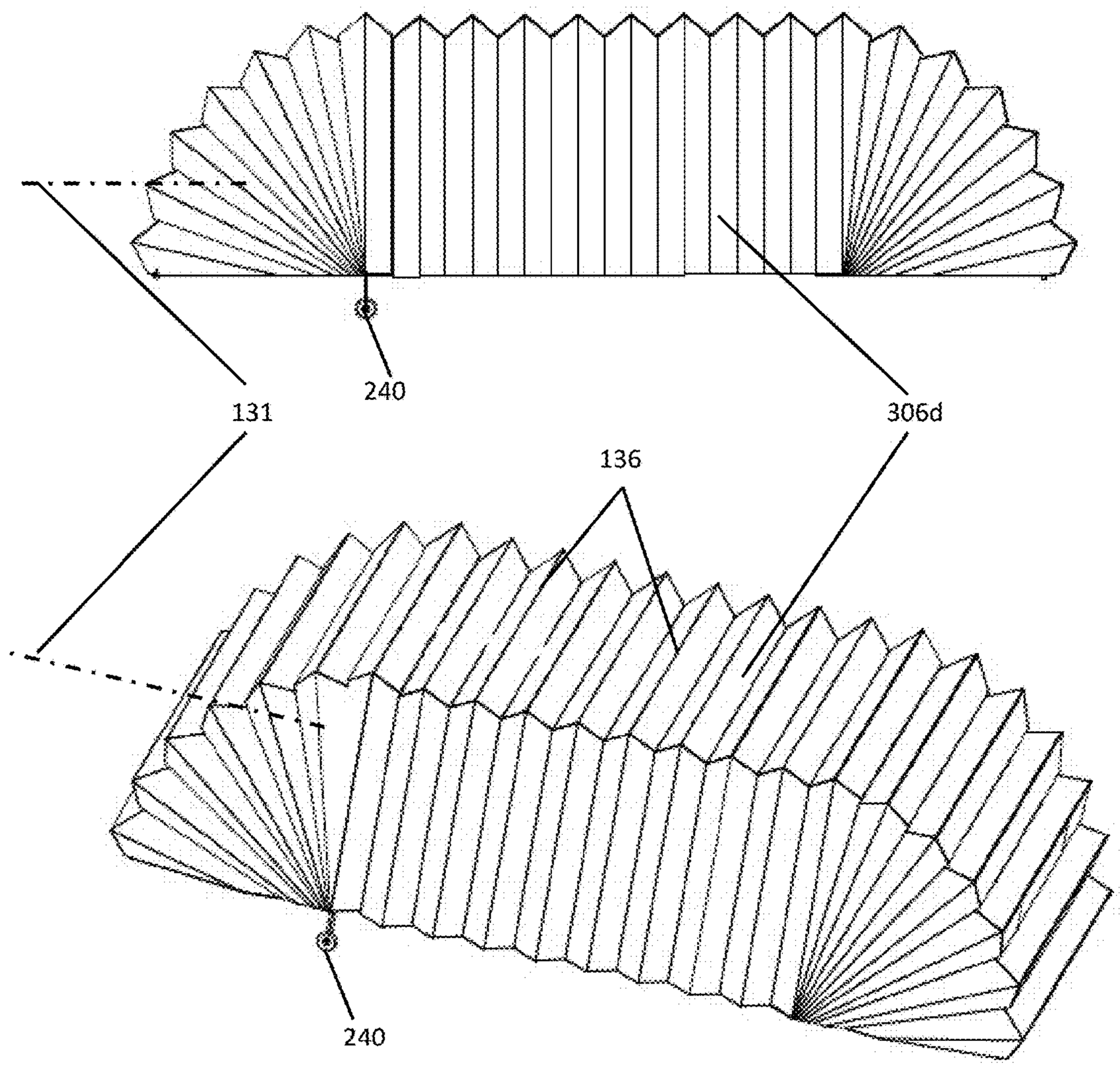


FIG. 3B

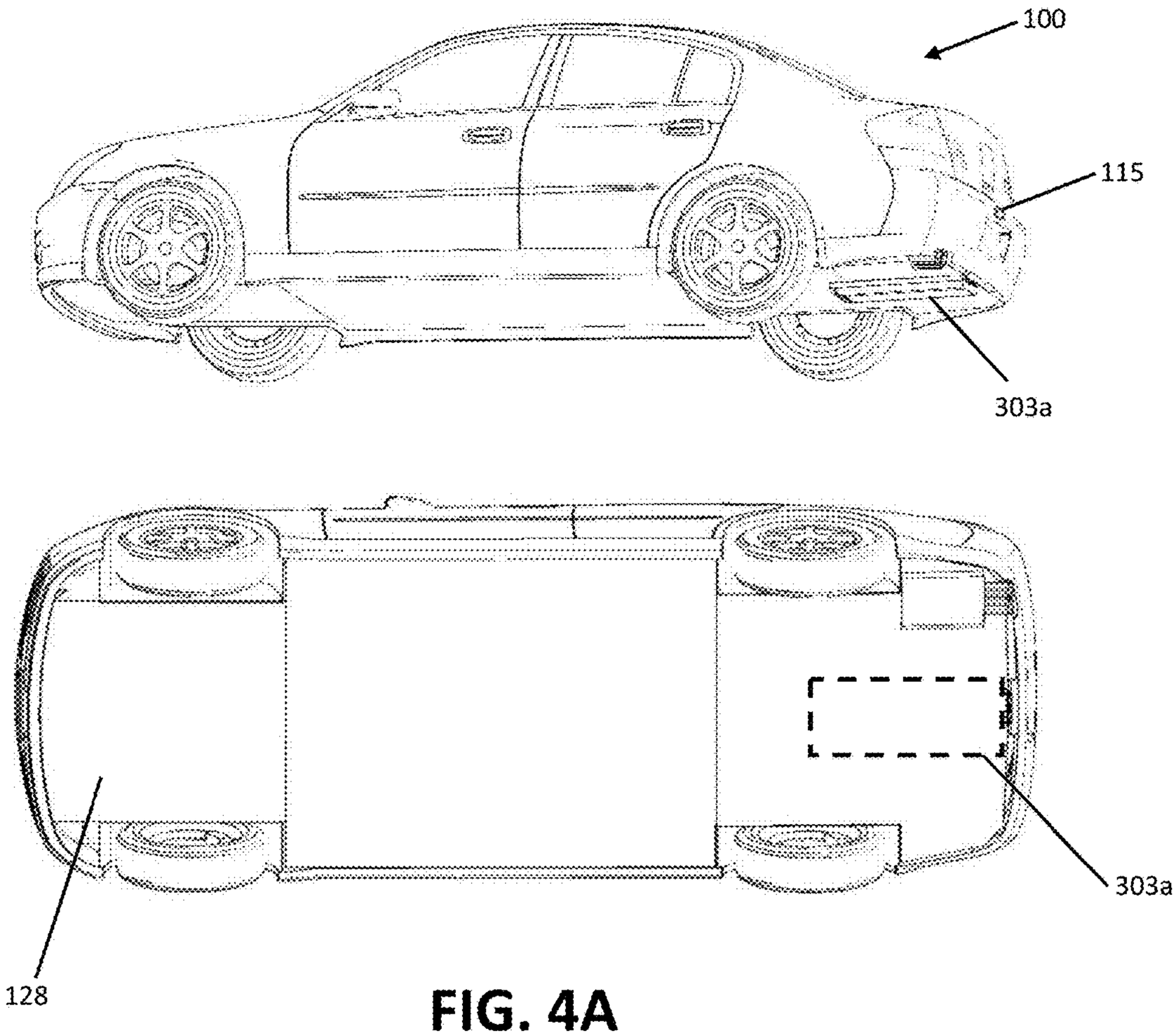


FIG. 4A

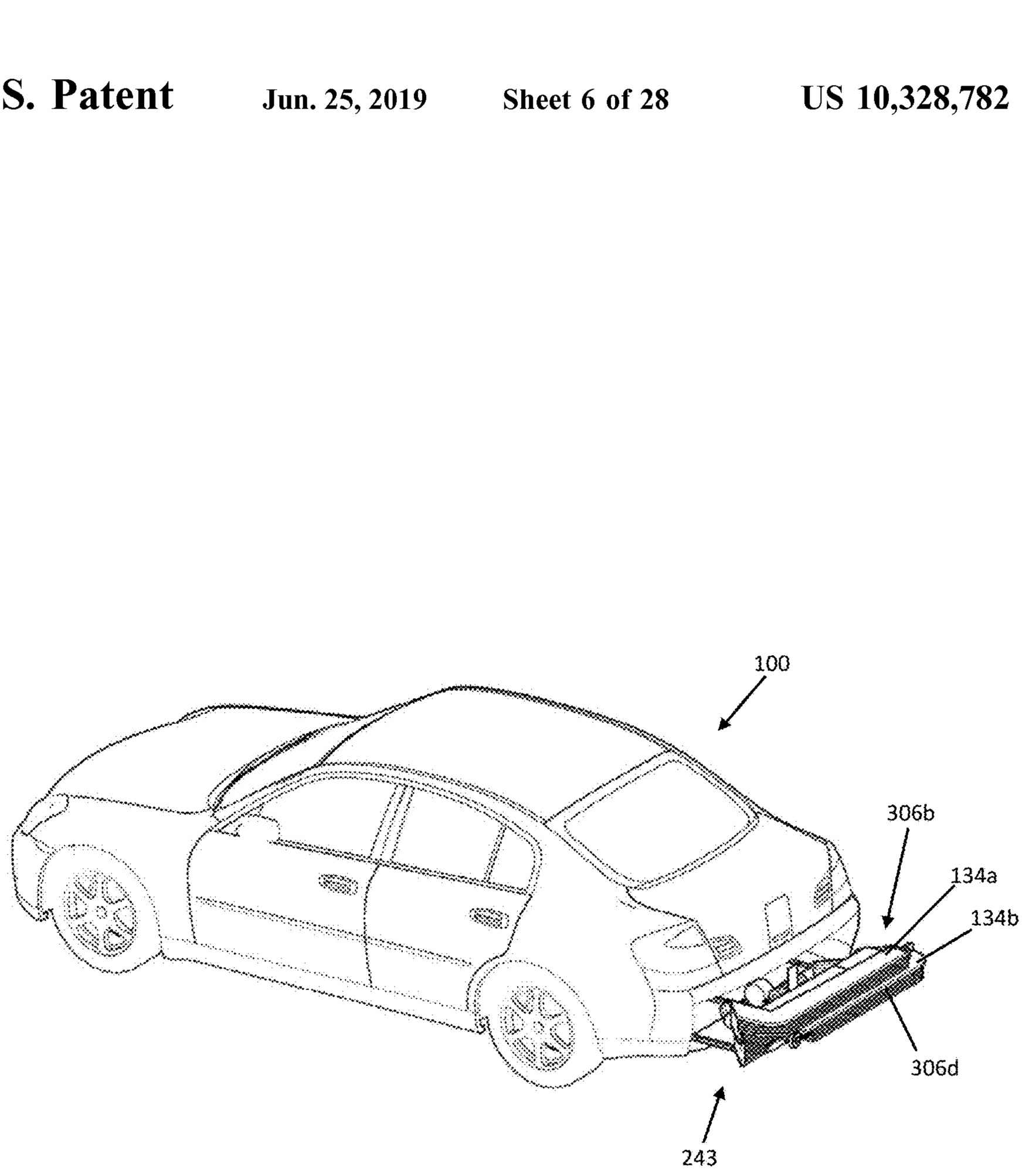


FIG. 4B

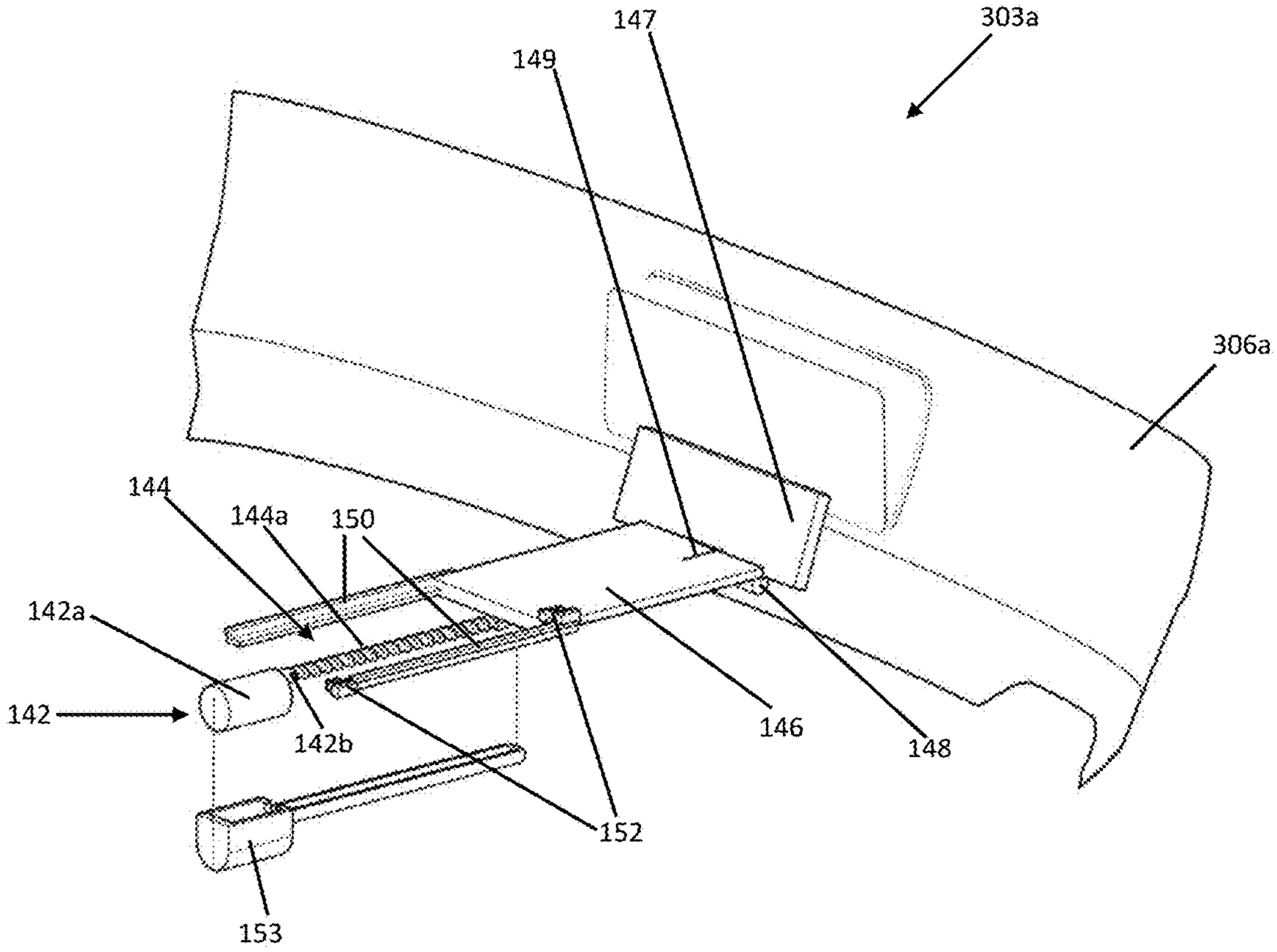
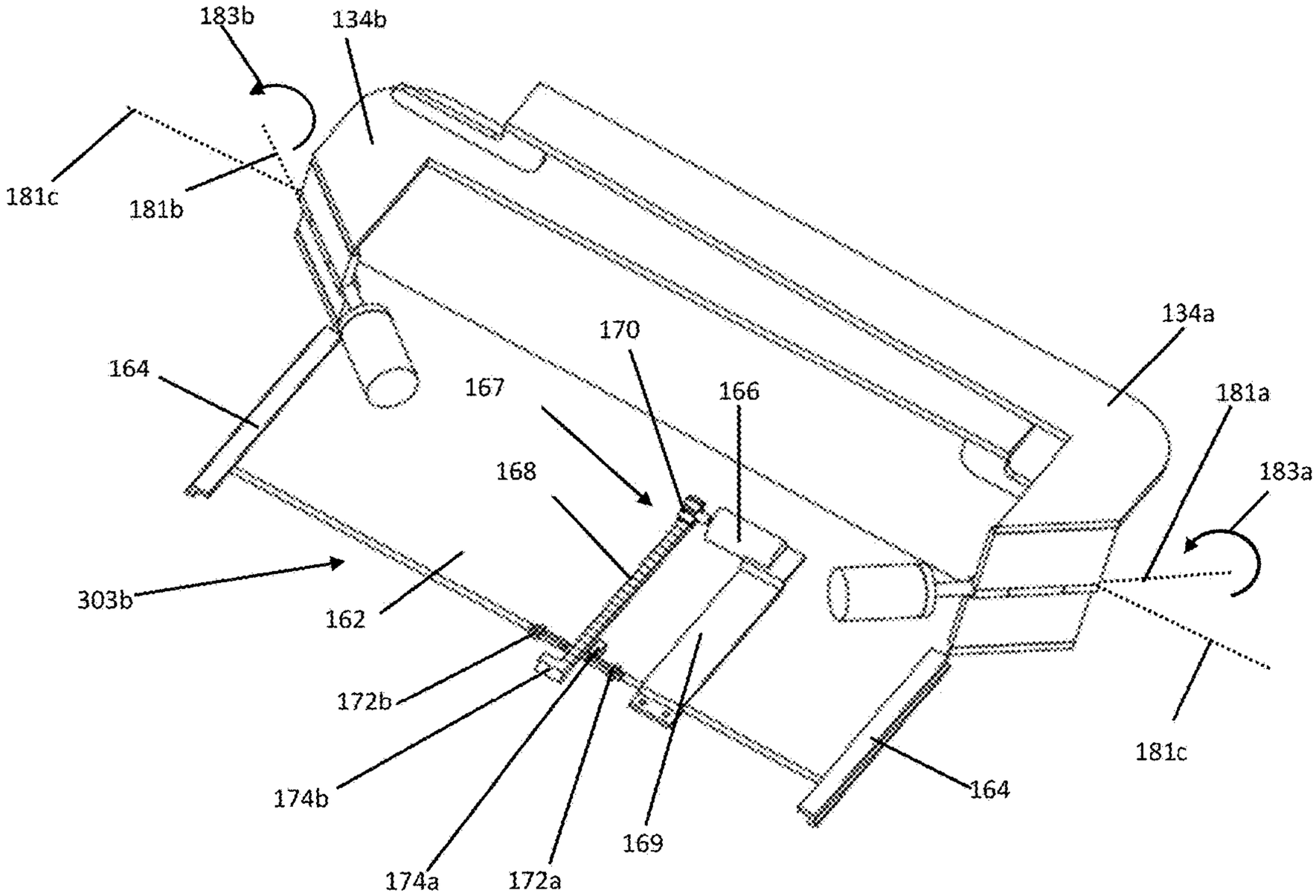


FIG. 5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134b
181c
181b
134a
170
164
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166
181a
183a
168
303b
162
172b
174b
174a
172a
169
164
181c

FIG. 6

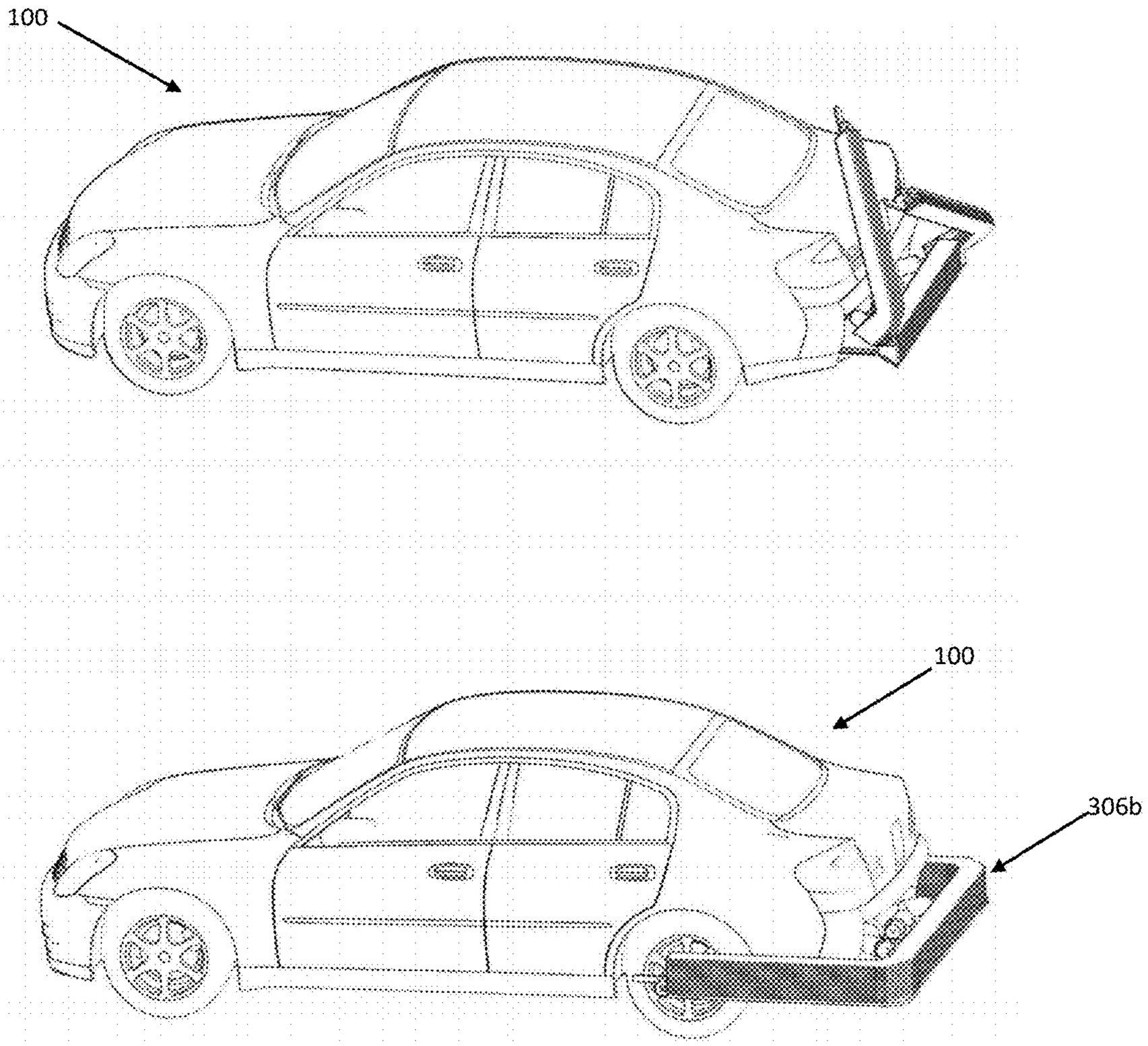
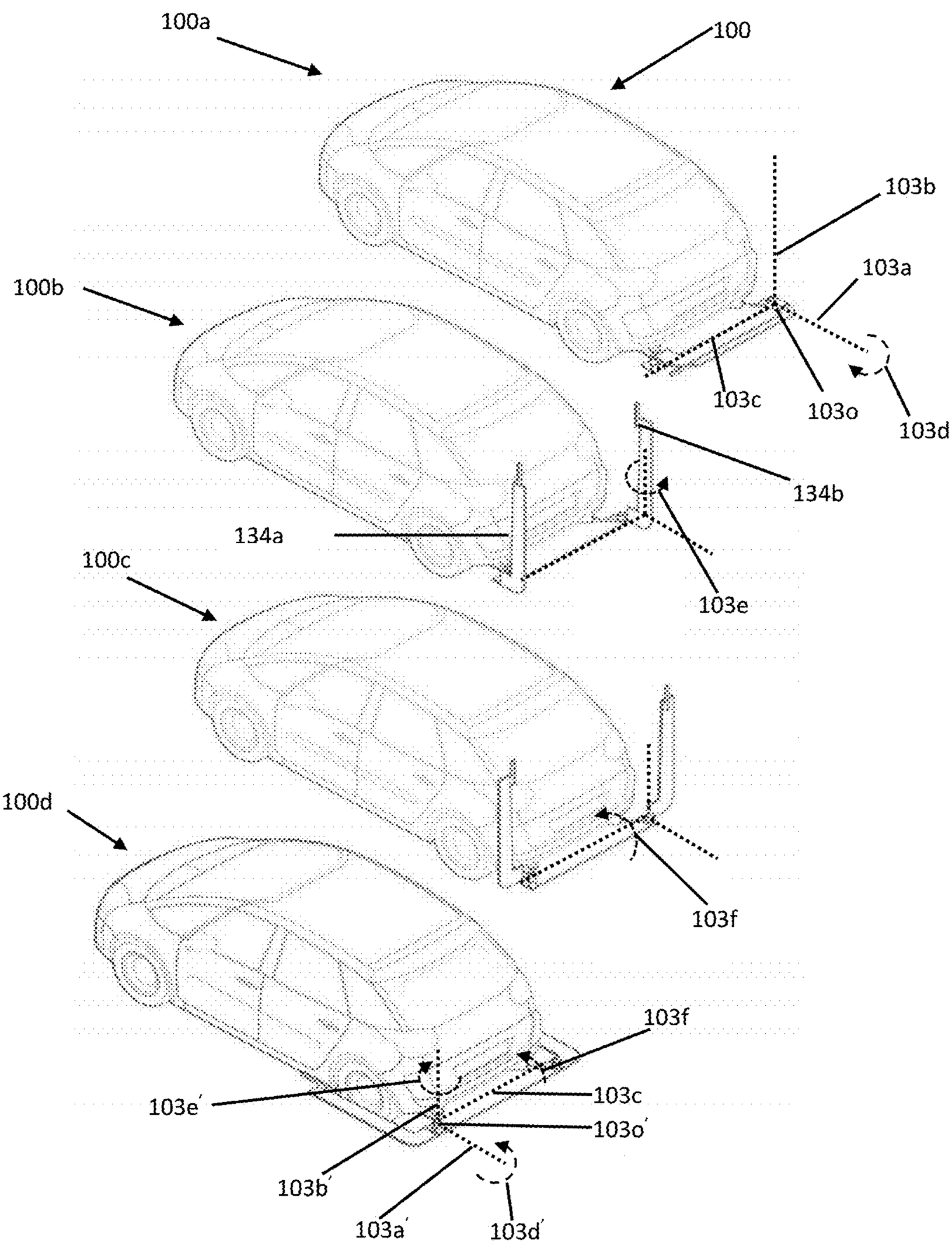


FIG. 7A


100a
100
103b
103a
100b
103c
103o
103d
134b
134a
100c
103e
100d
103f
103f'
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103c'
103o'
103b'
103a'
103d'

FIG. 7B

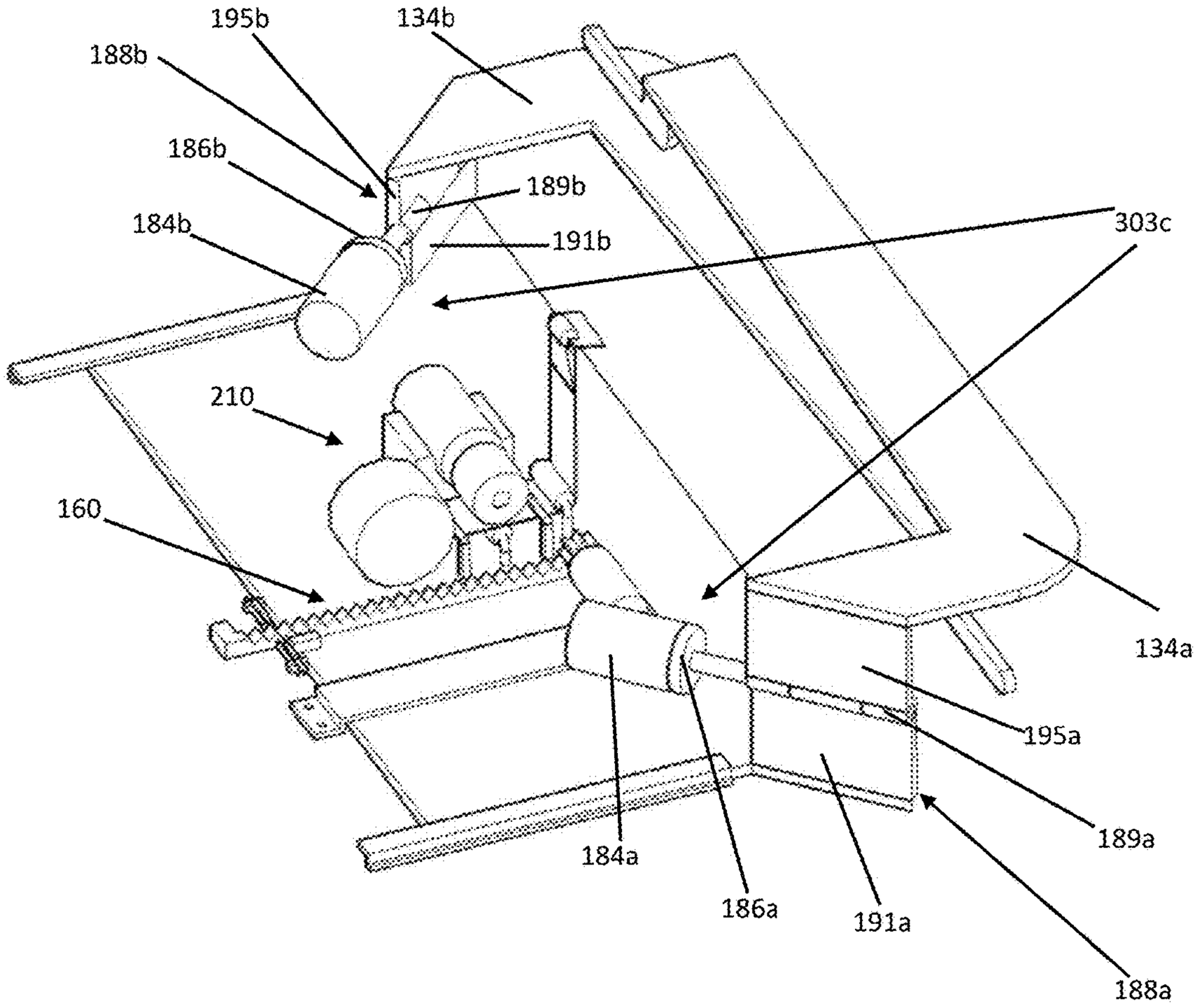

195b
134b
188b
186b
189b
184b
191b
303c
210
160
134a
195a
189a
184a
186a
191a
188a

FIG. 8A

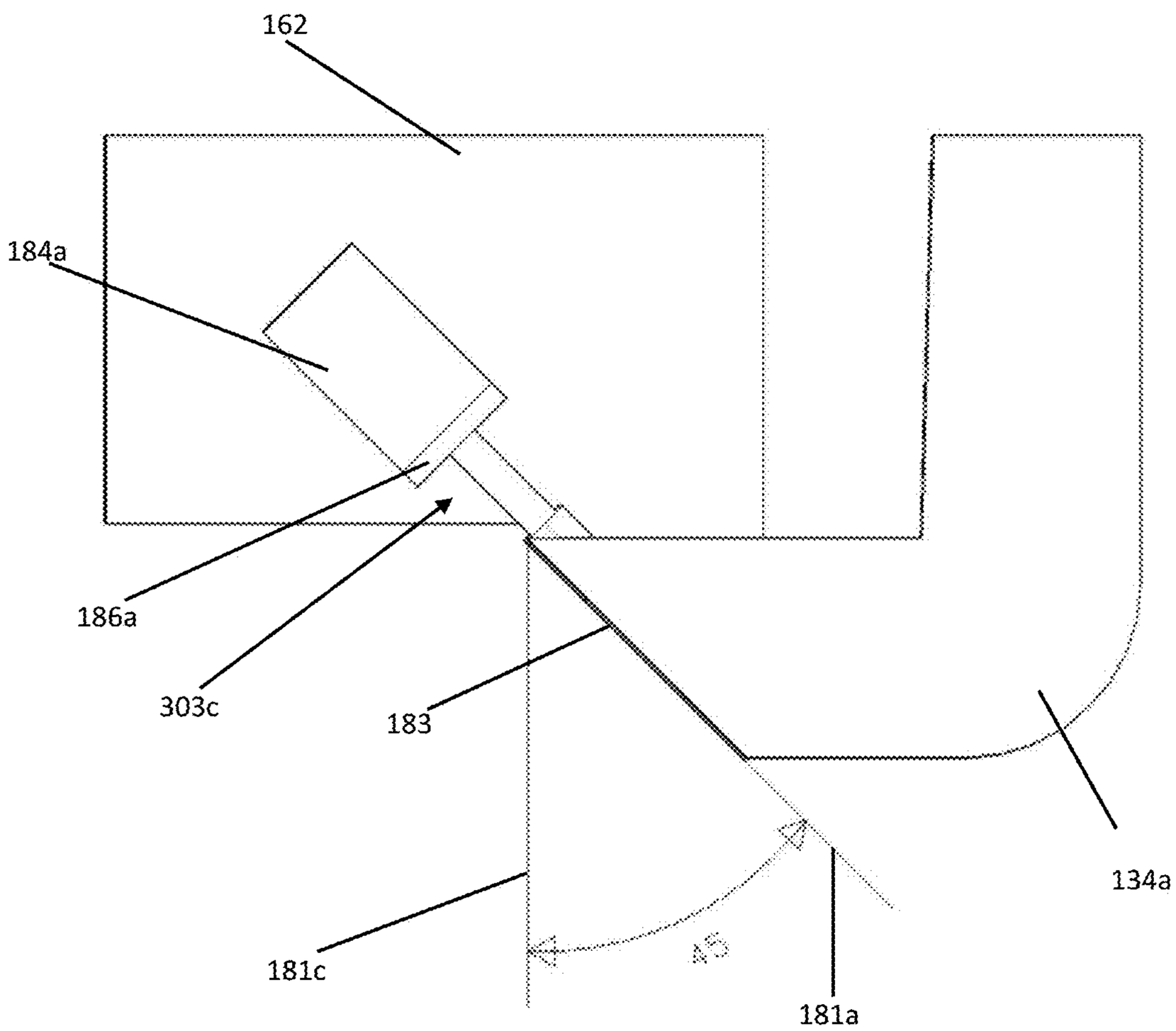
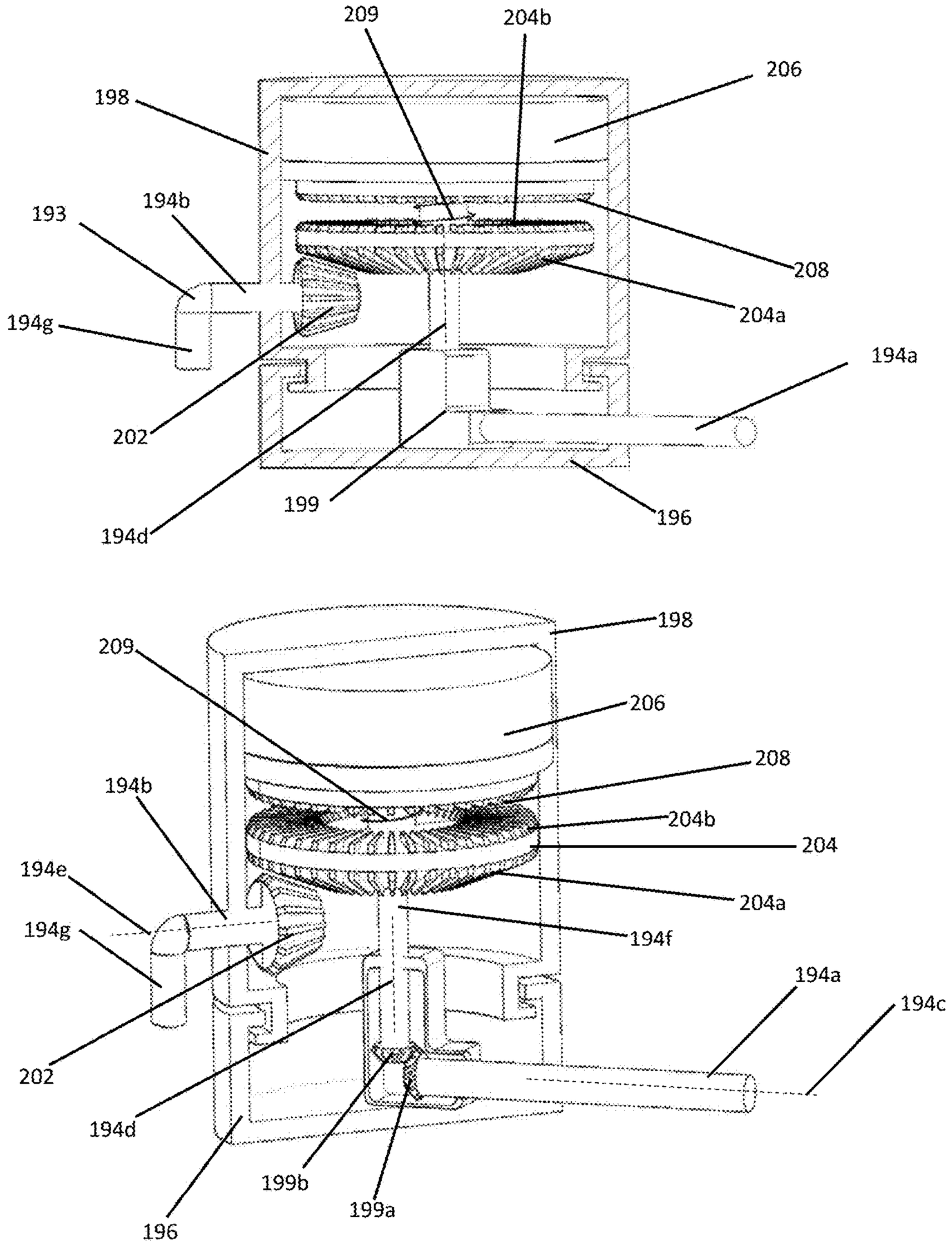


FIG. 8B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204b
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198
194b
193
208
204a
194g
194a
202
199
196
194d
198
209
206
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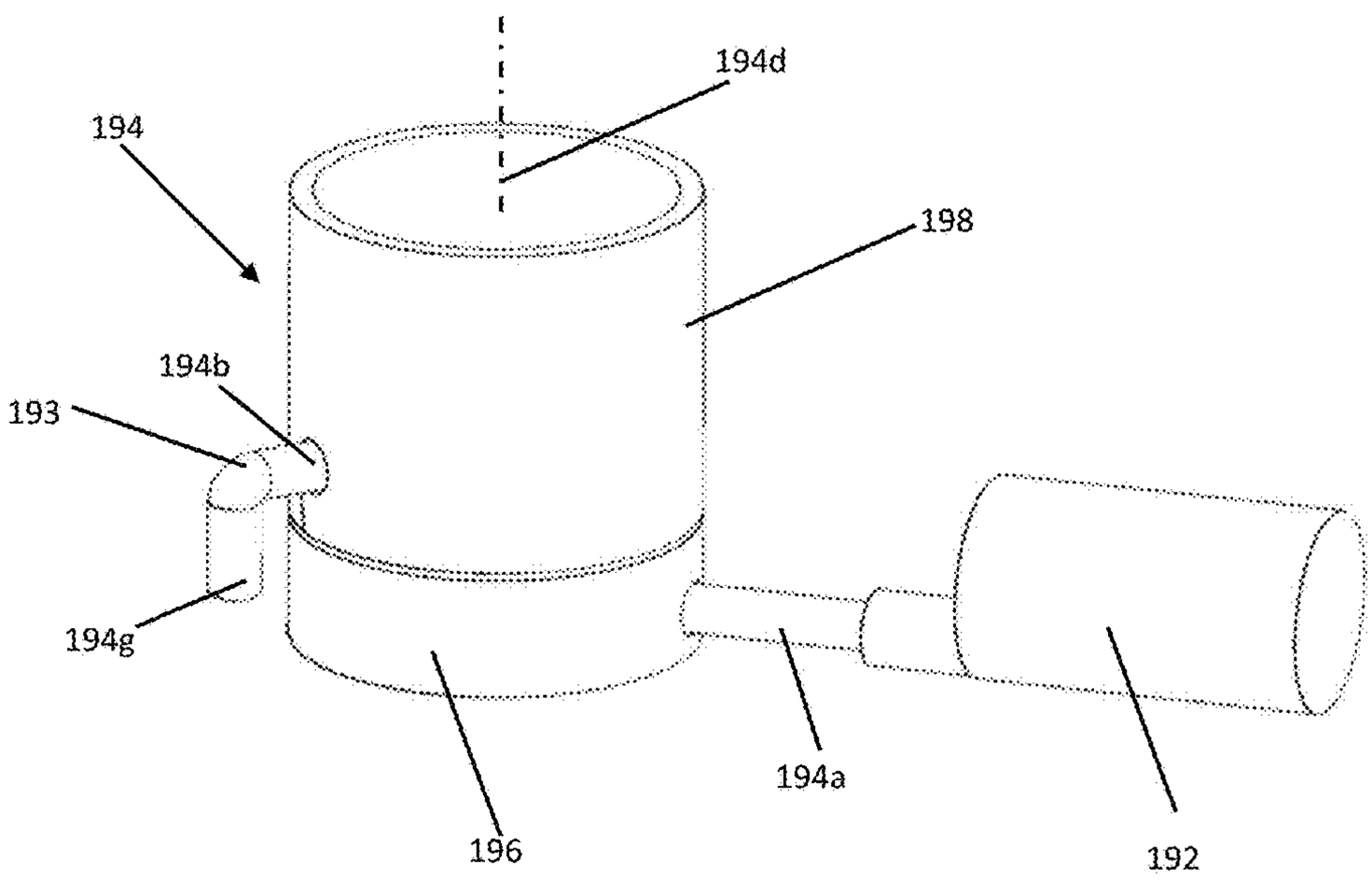
194b
204b
204
194e
204a
194g
194f
194a
194c
202
194d
199b
199a
196

FIG. 9A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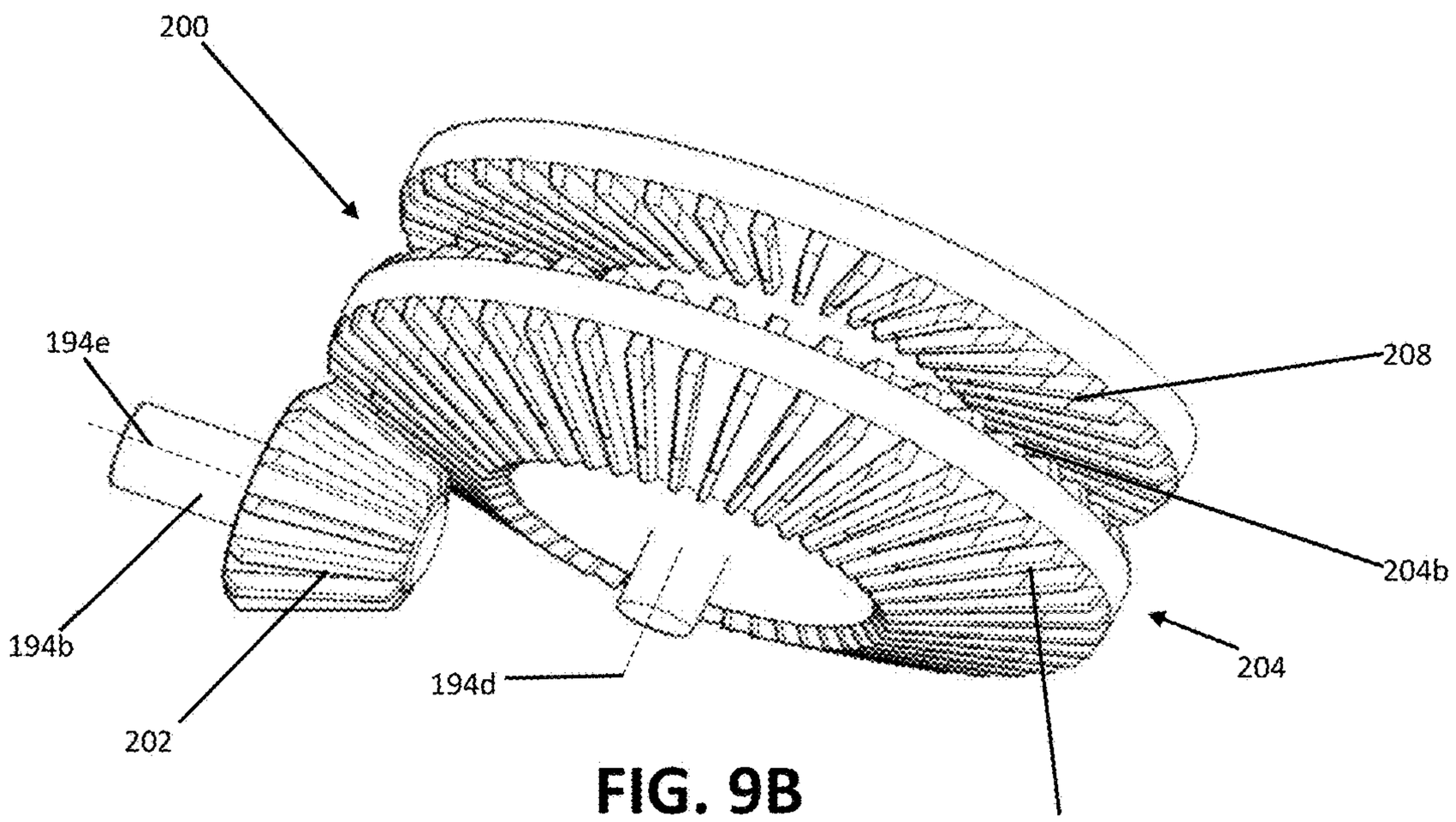
194d
198
194b
193
194g
196
194a
192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194e
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204b
194b
202
194d
204

FIG. 9B

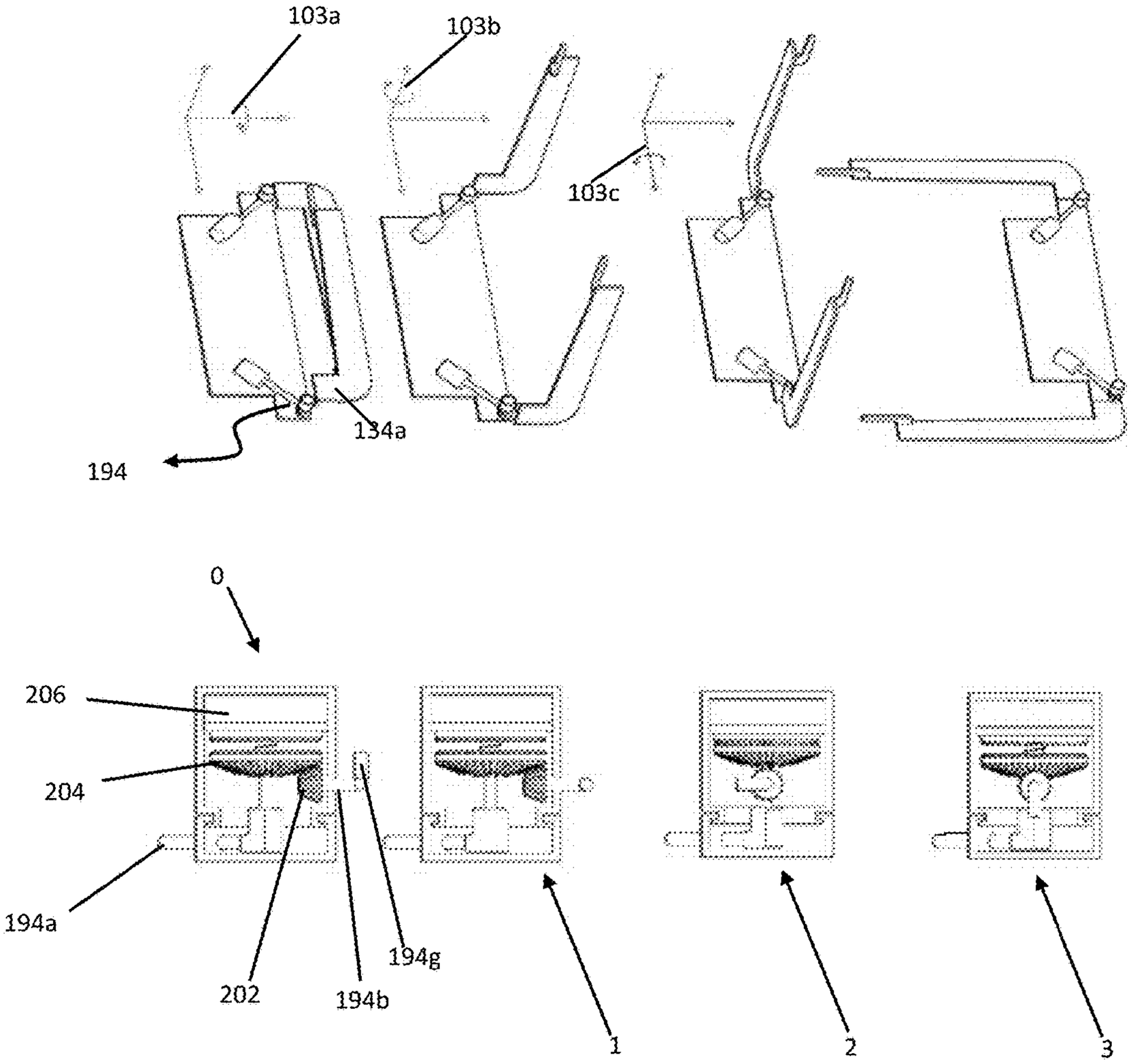
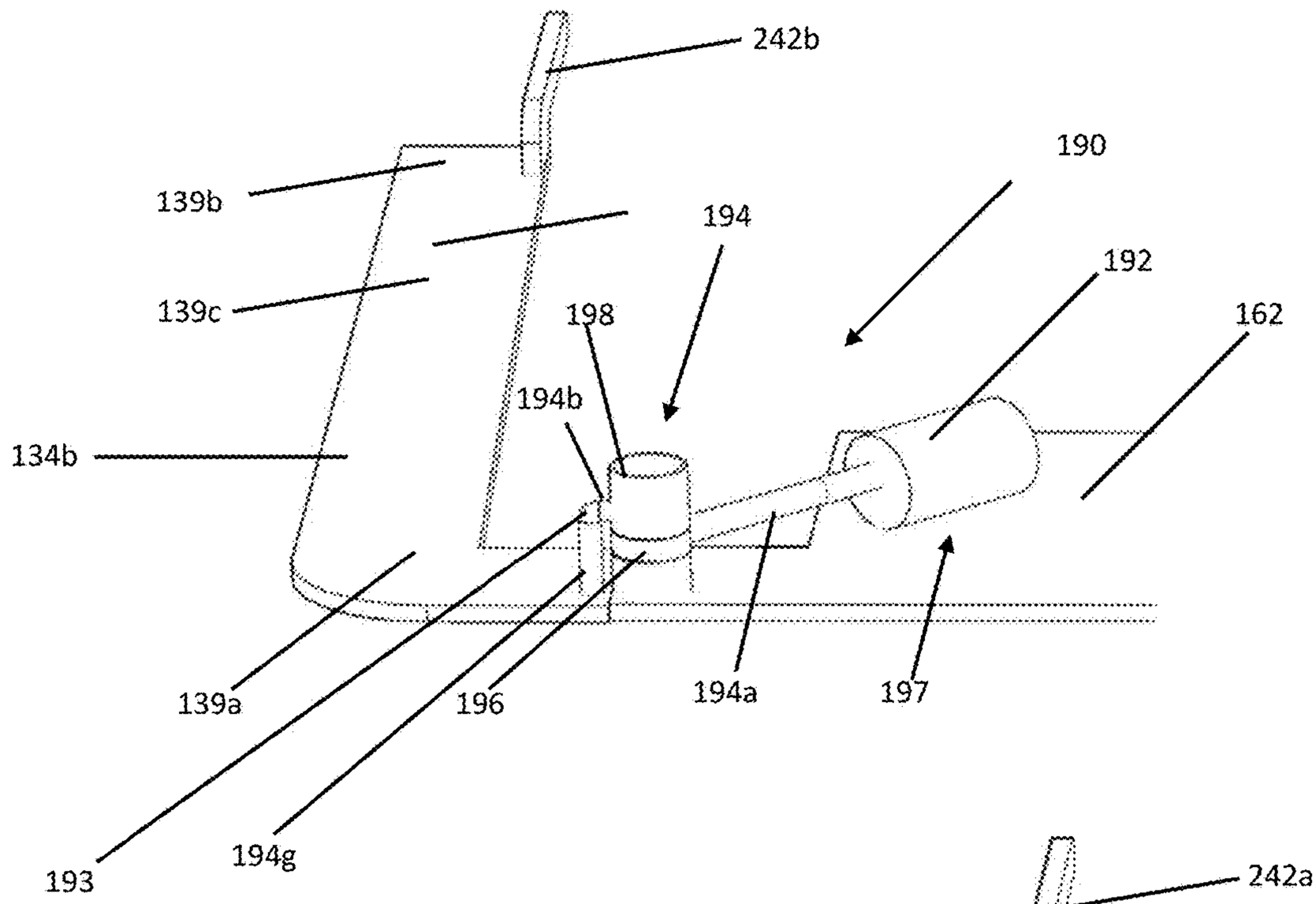


FIG. 9C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190
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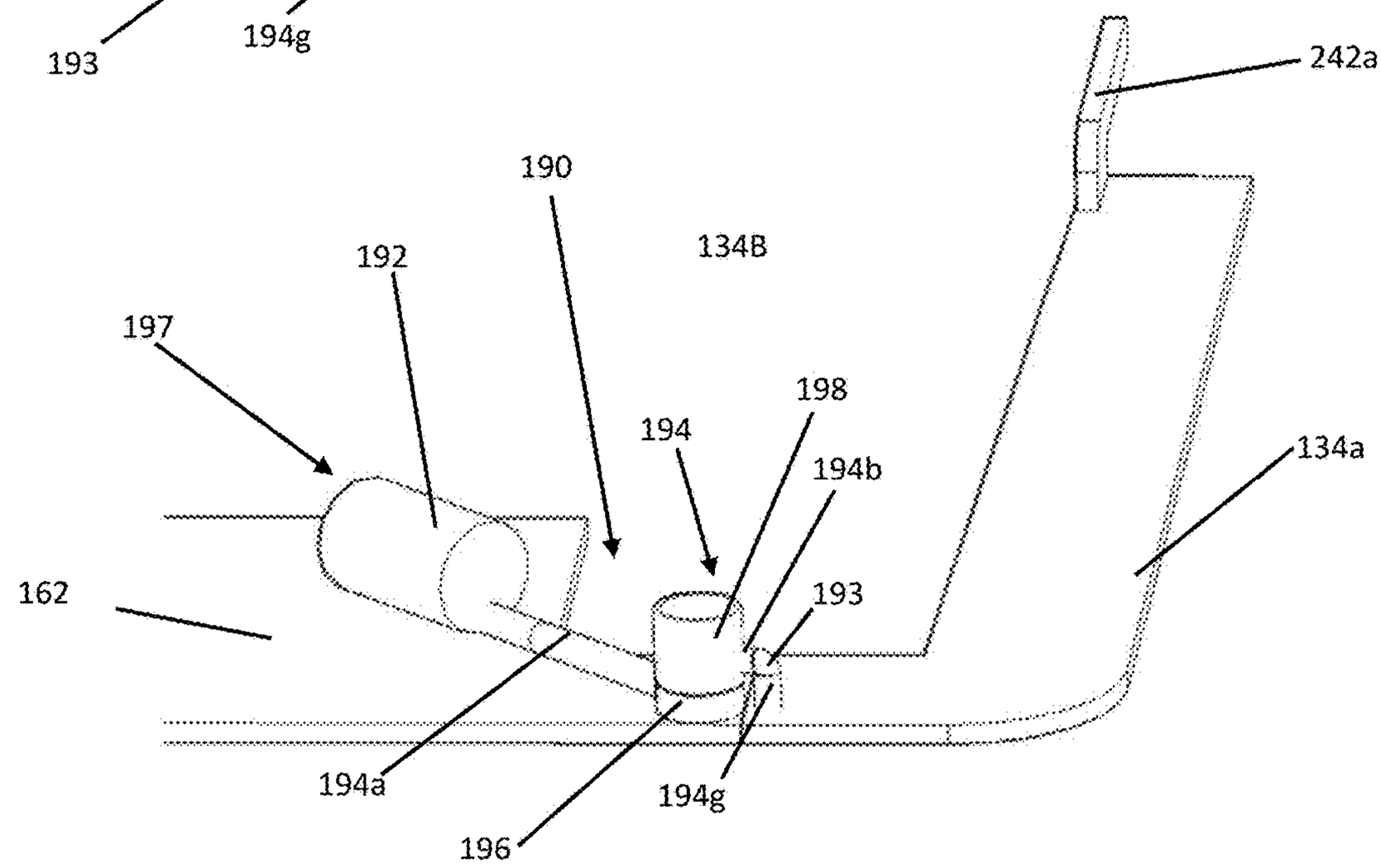
194
192
198
162
194b
134b
139c
139a
196
194a
197
193
194g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190
134B
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197
198
194
194b
134a
162
193
194a
194g
196

FIG. 9D

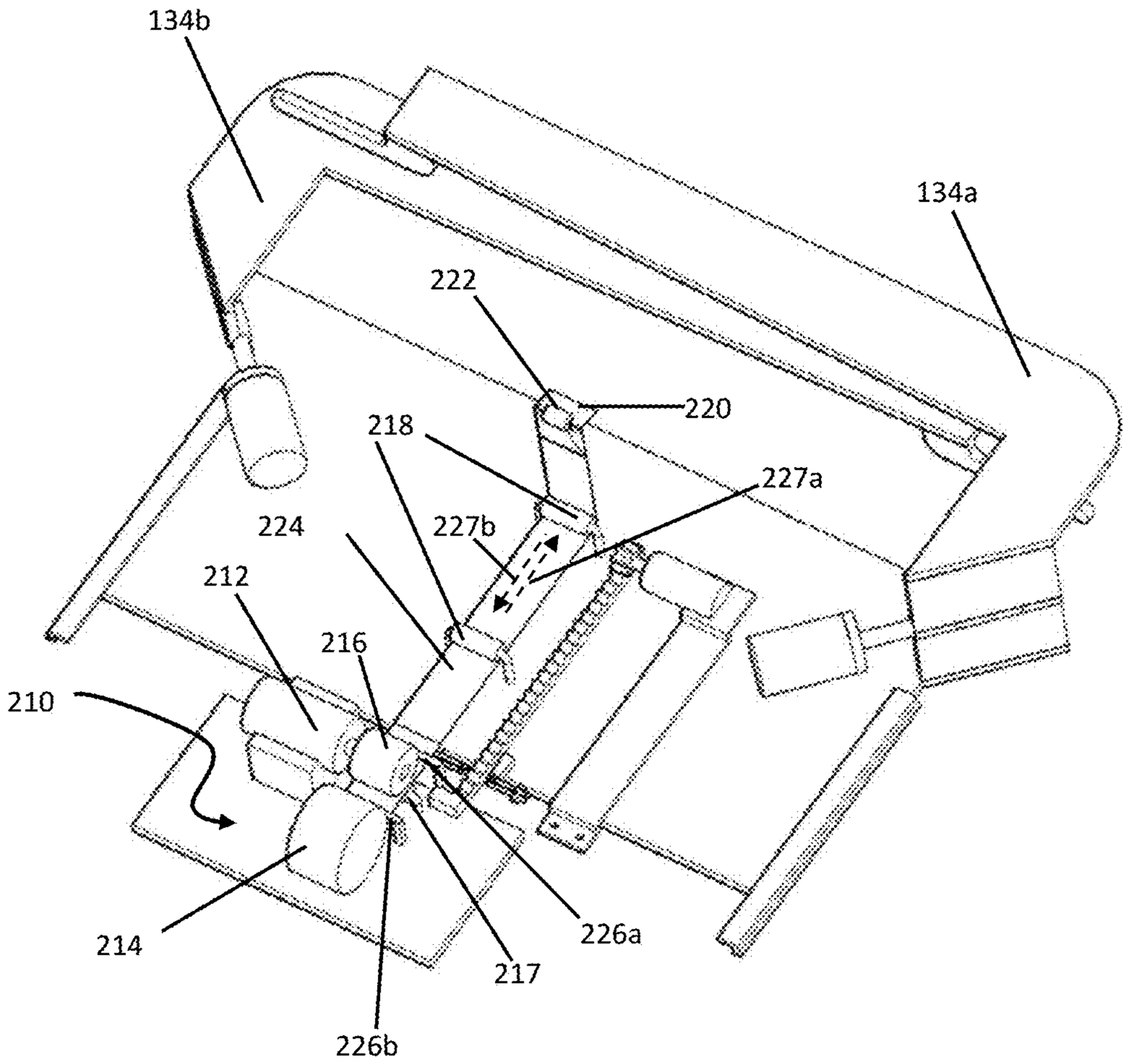

134b
134a
222
220
218
227a
224
227b
212
216
210
214
226a
217
226b

FIG. 10

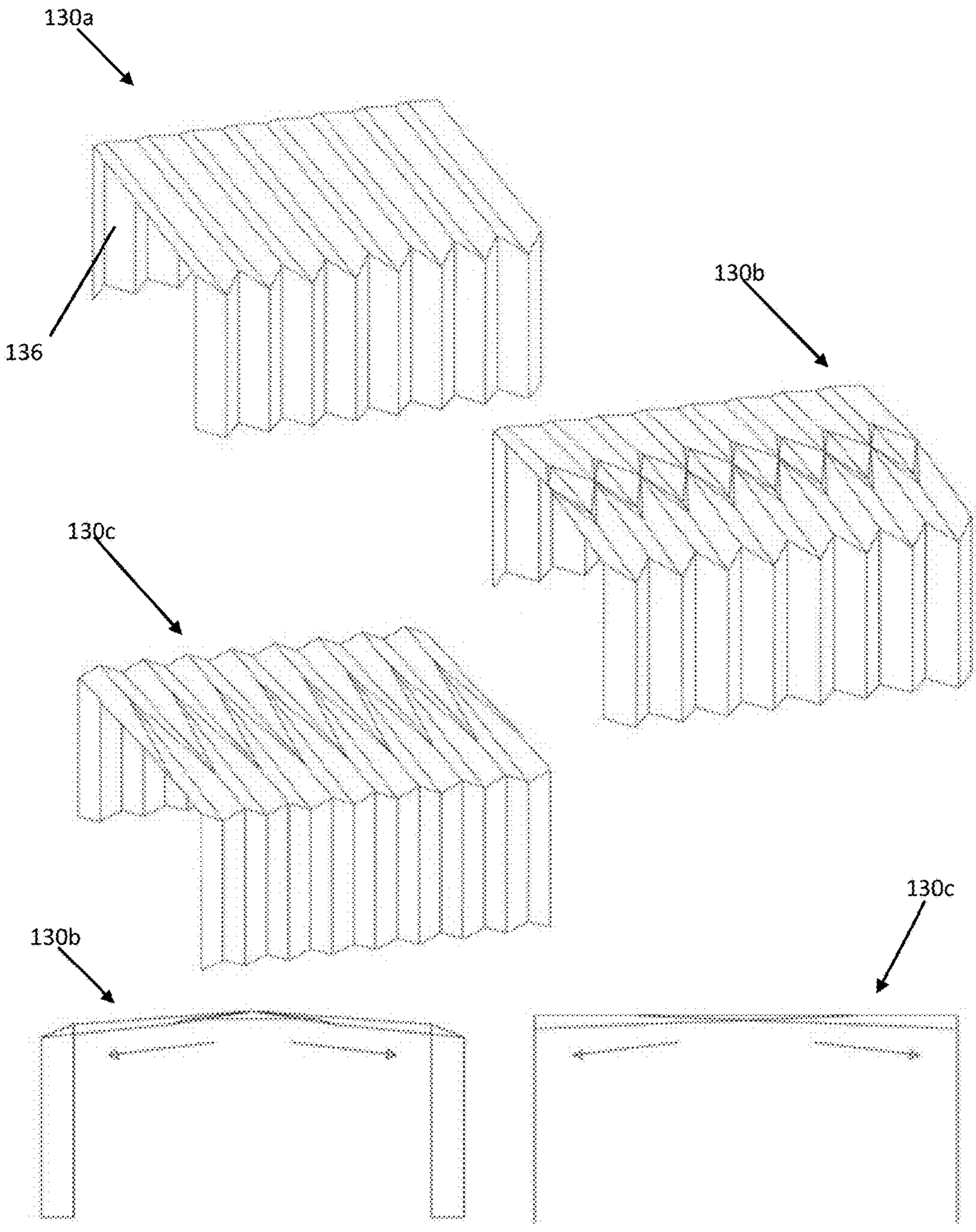


FIG. 11A

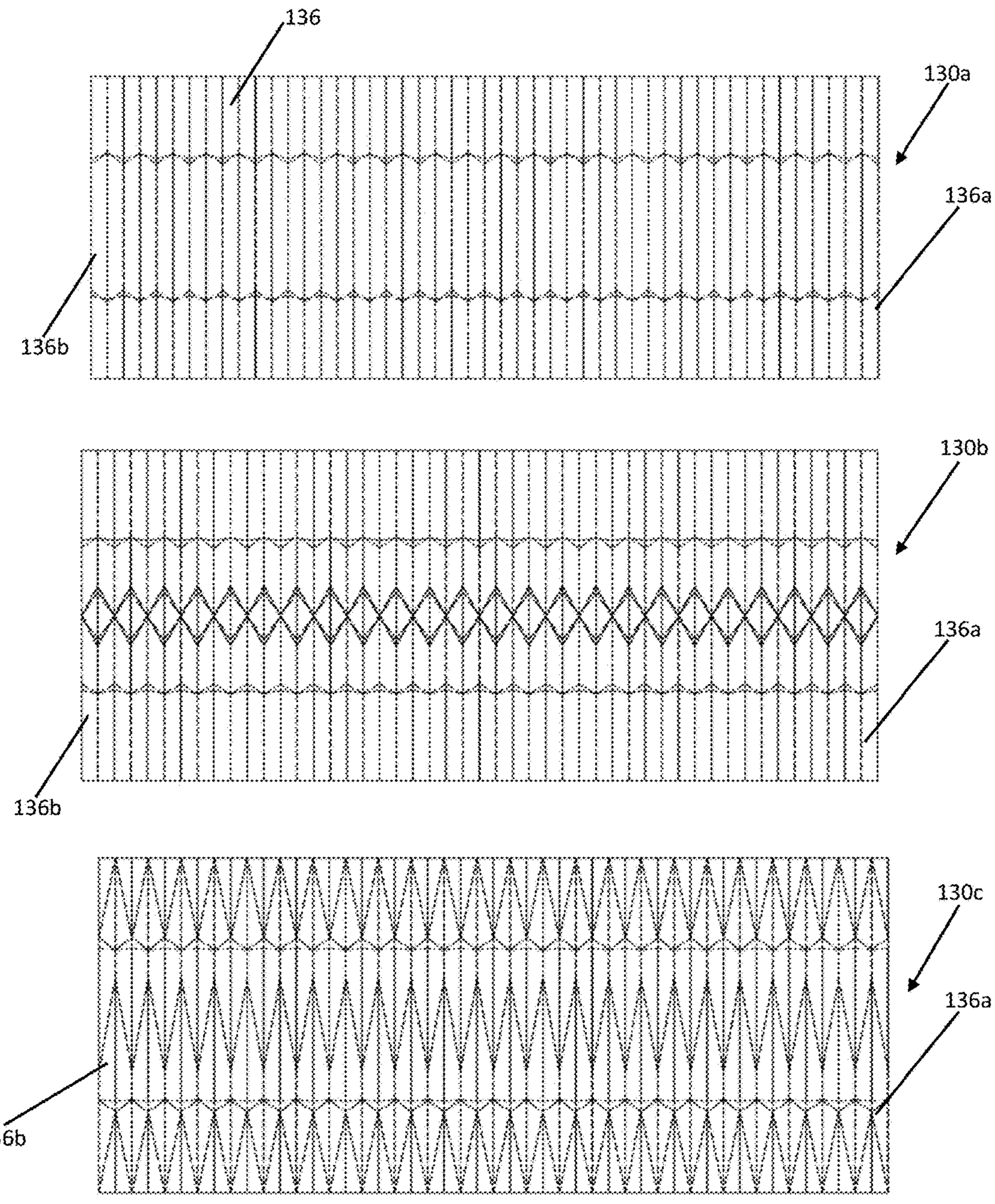


FIG. 11B

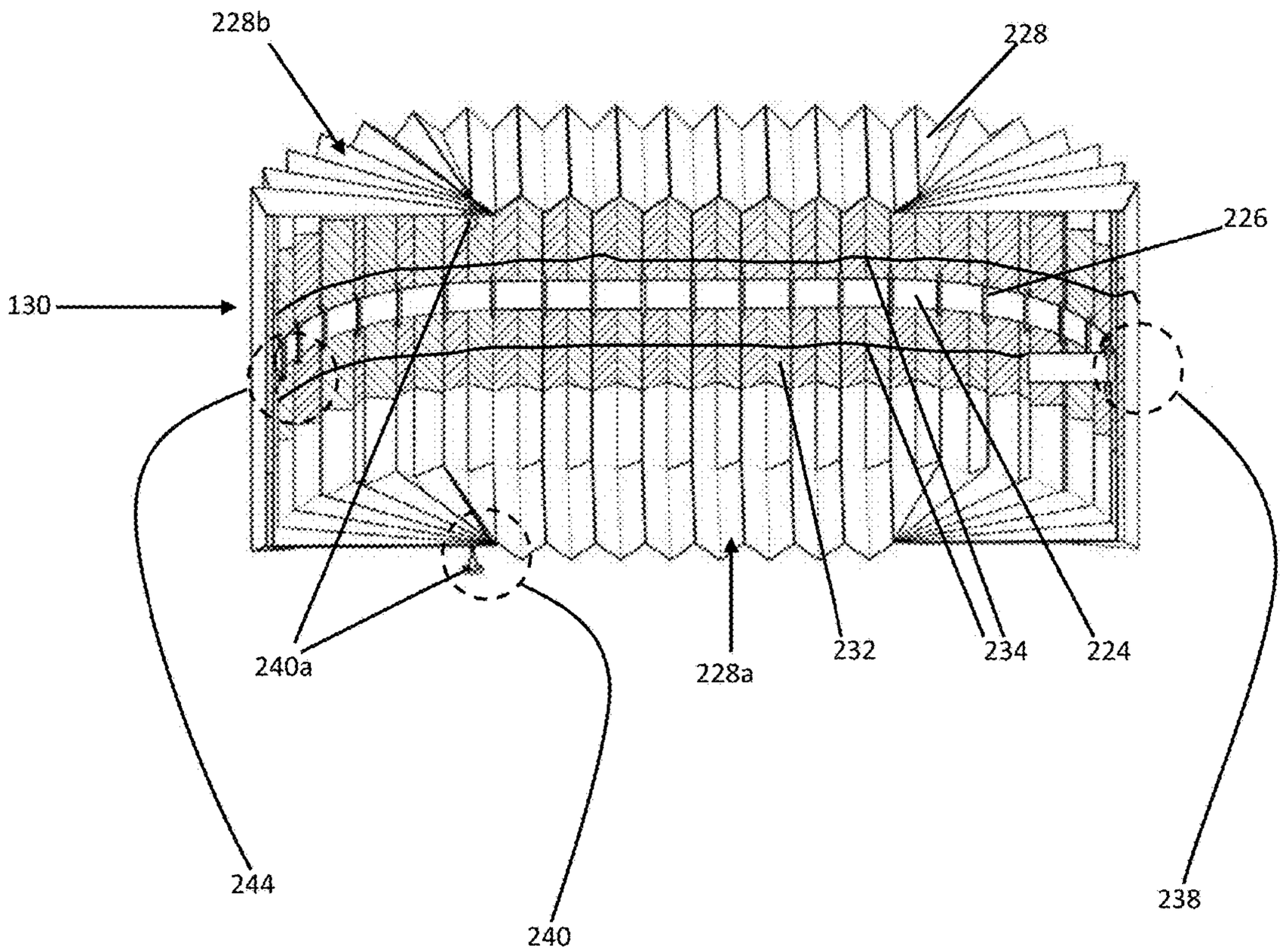


FIG 12A

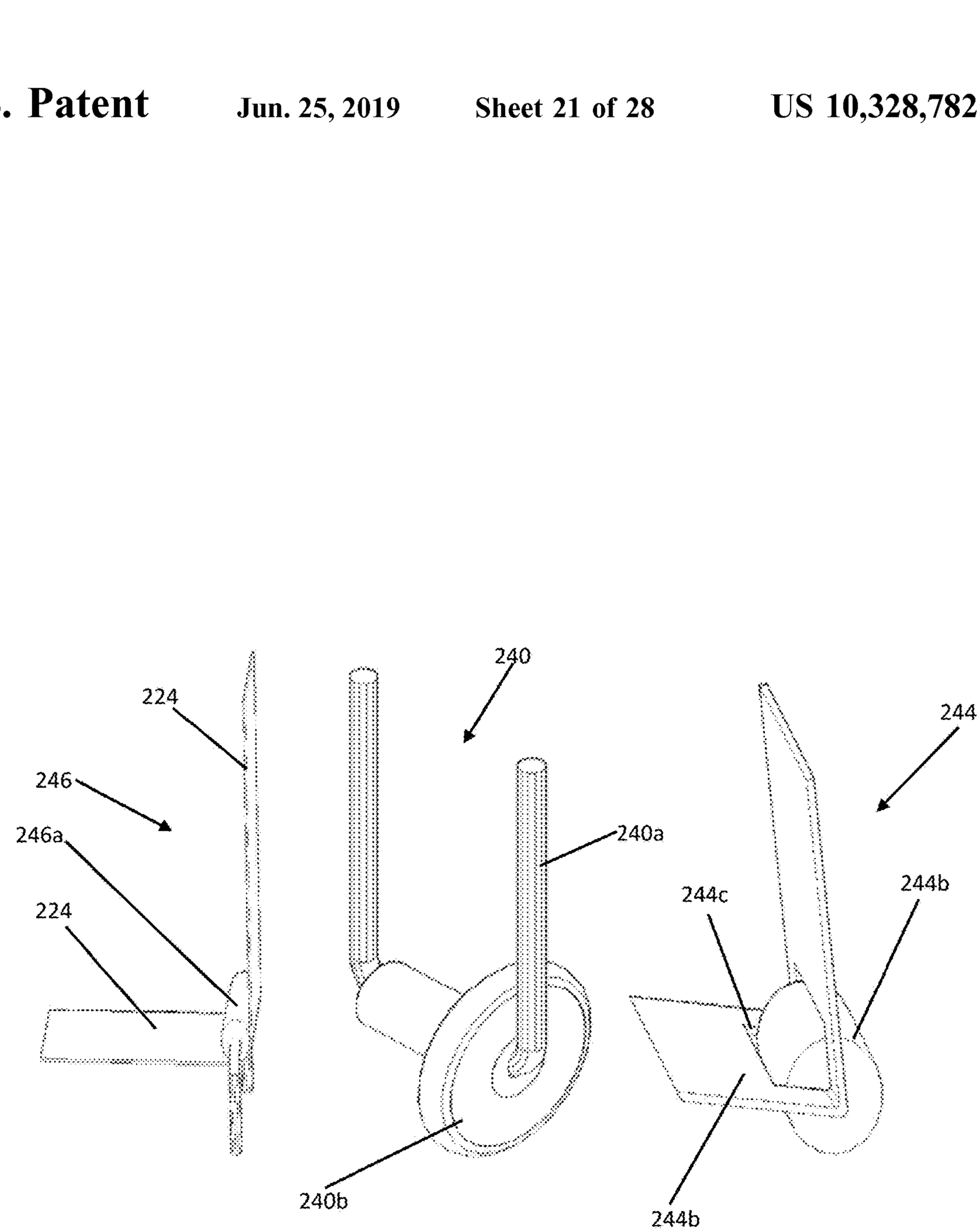
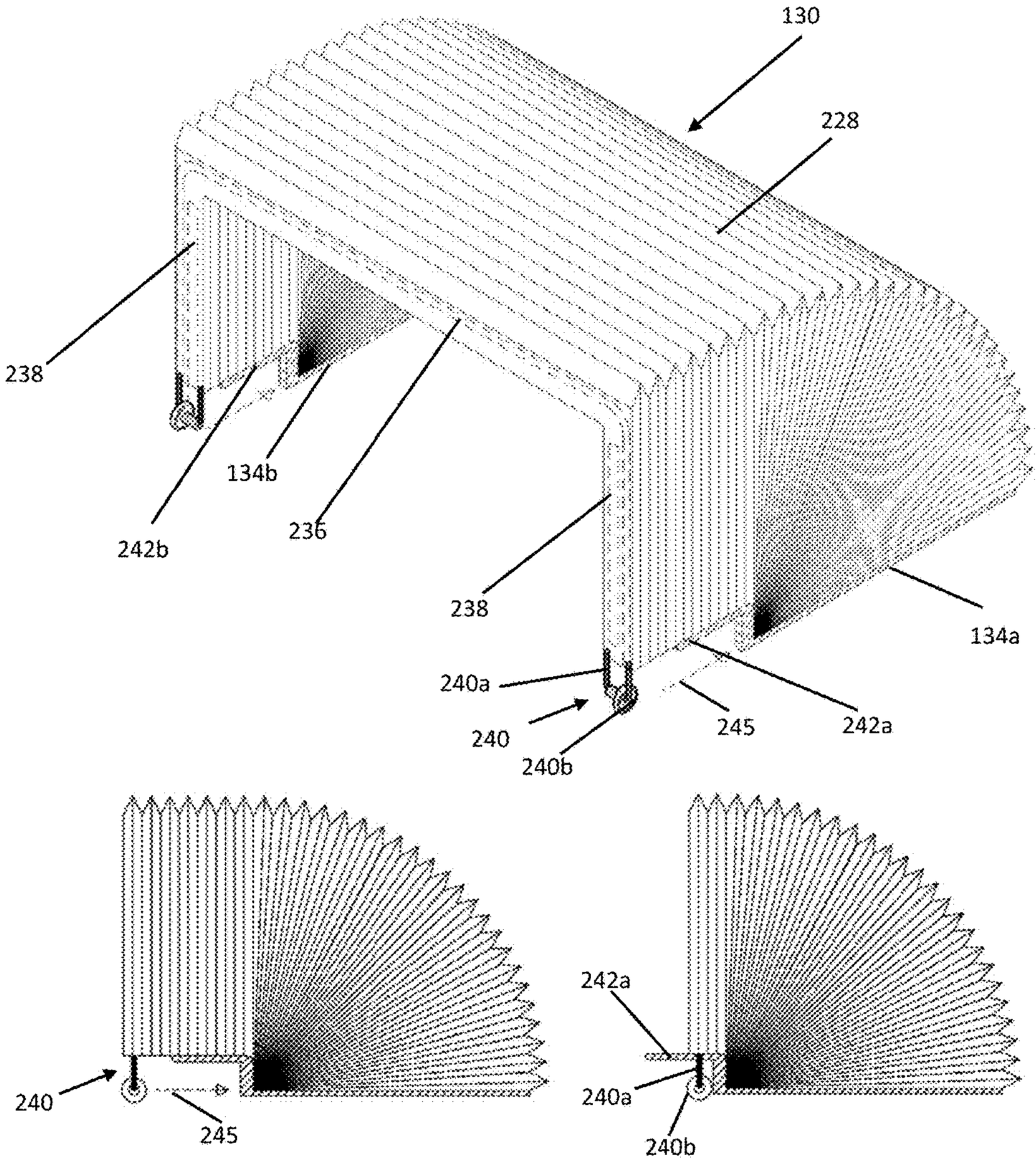


FIG. 12B


130
228
238
134b
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238
134a
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240
245
242a
240b
240
245
242a
240a
240b

FIG. 13

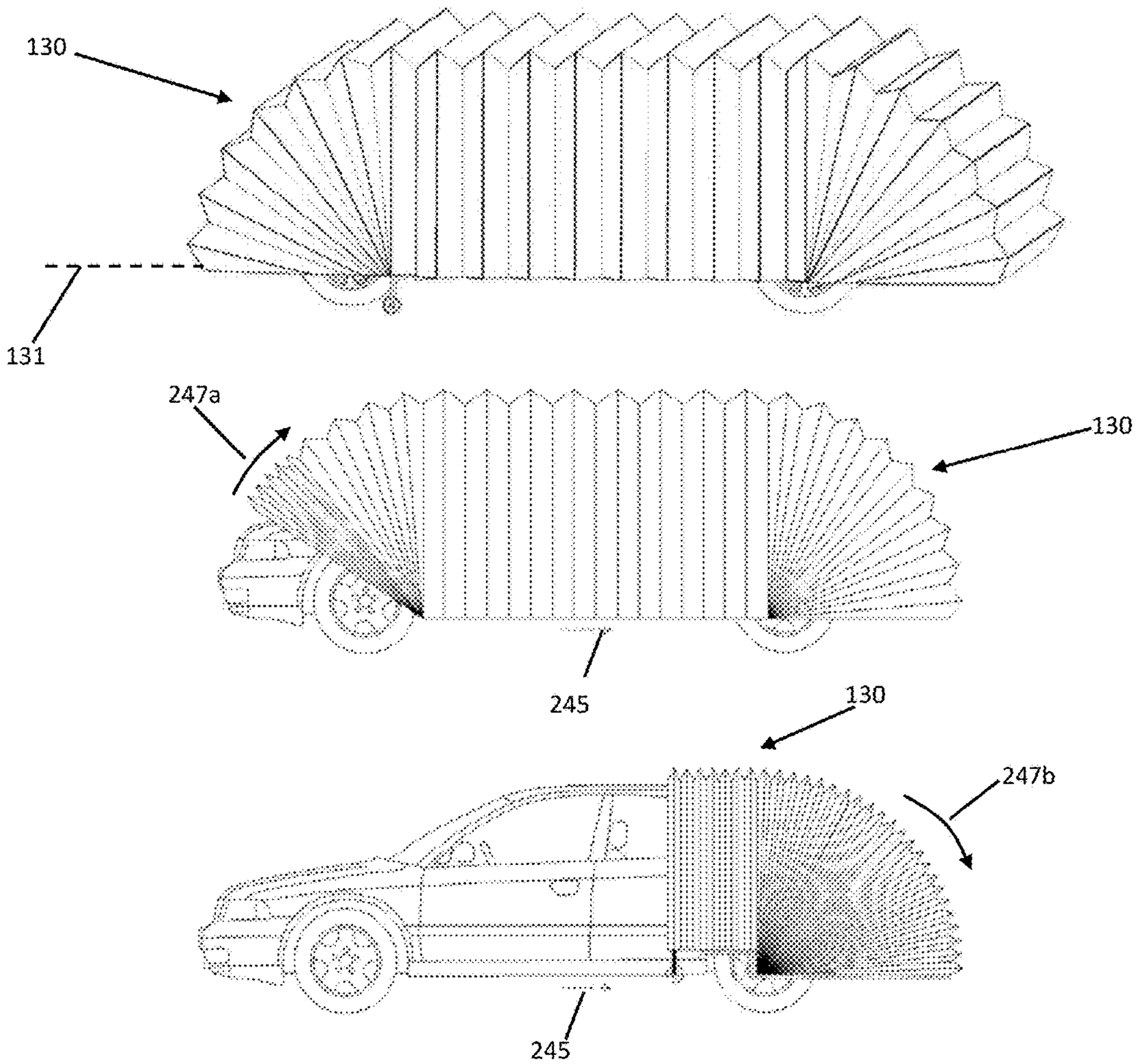

FIG 14

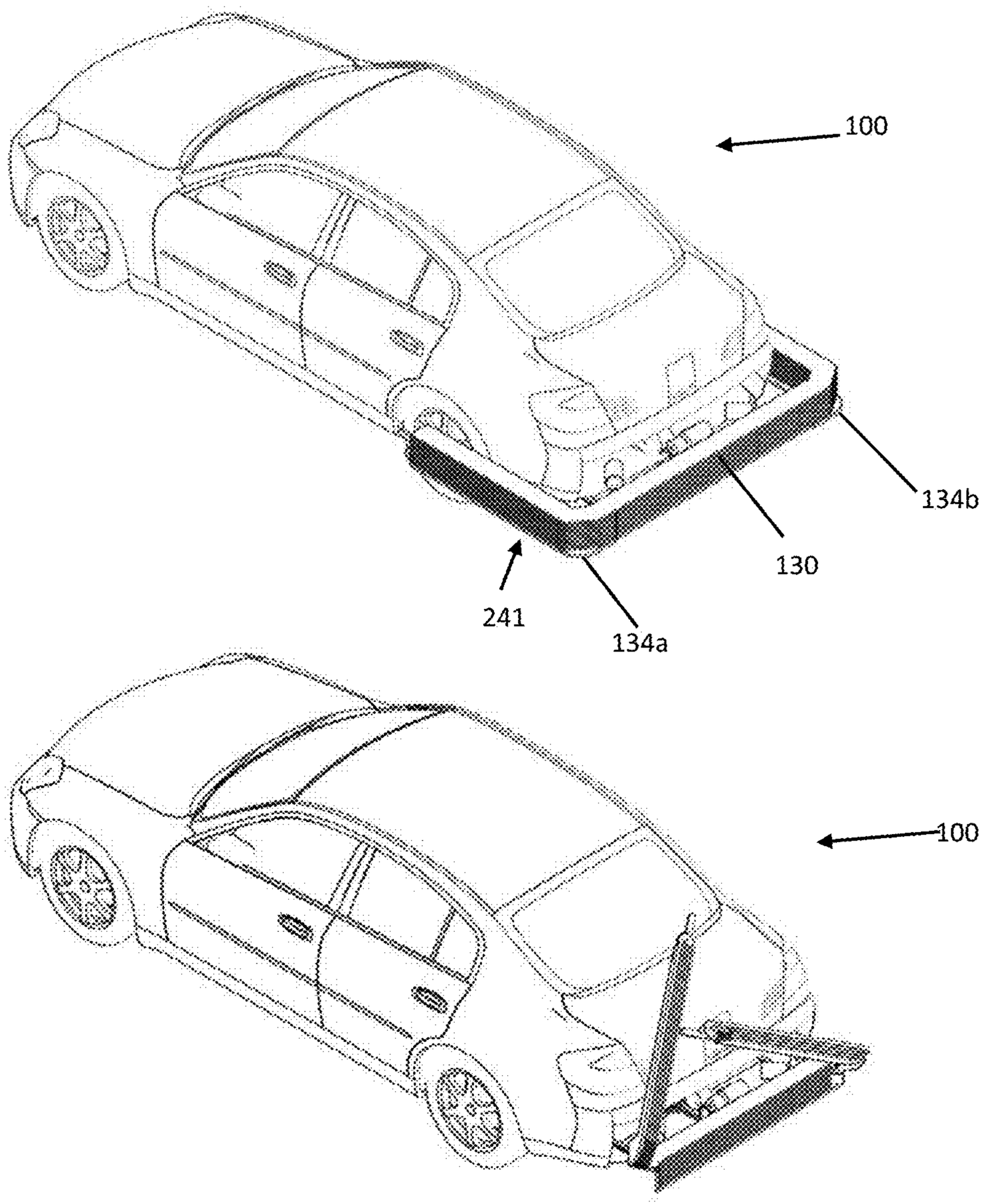

FIG. 15A

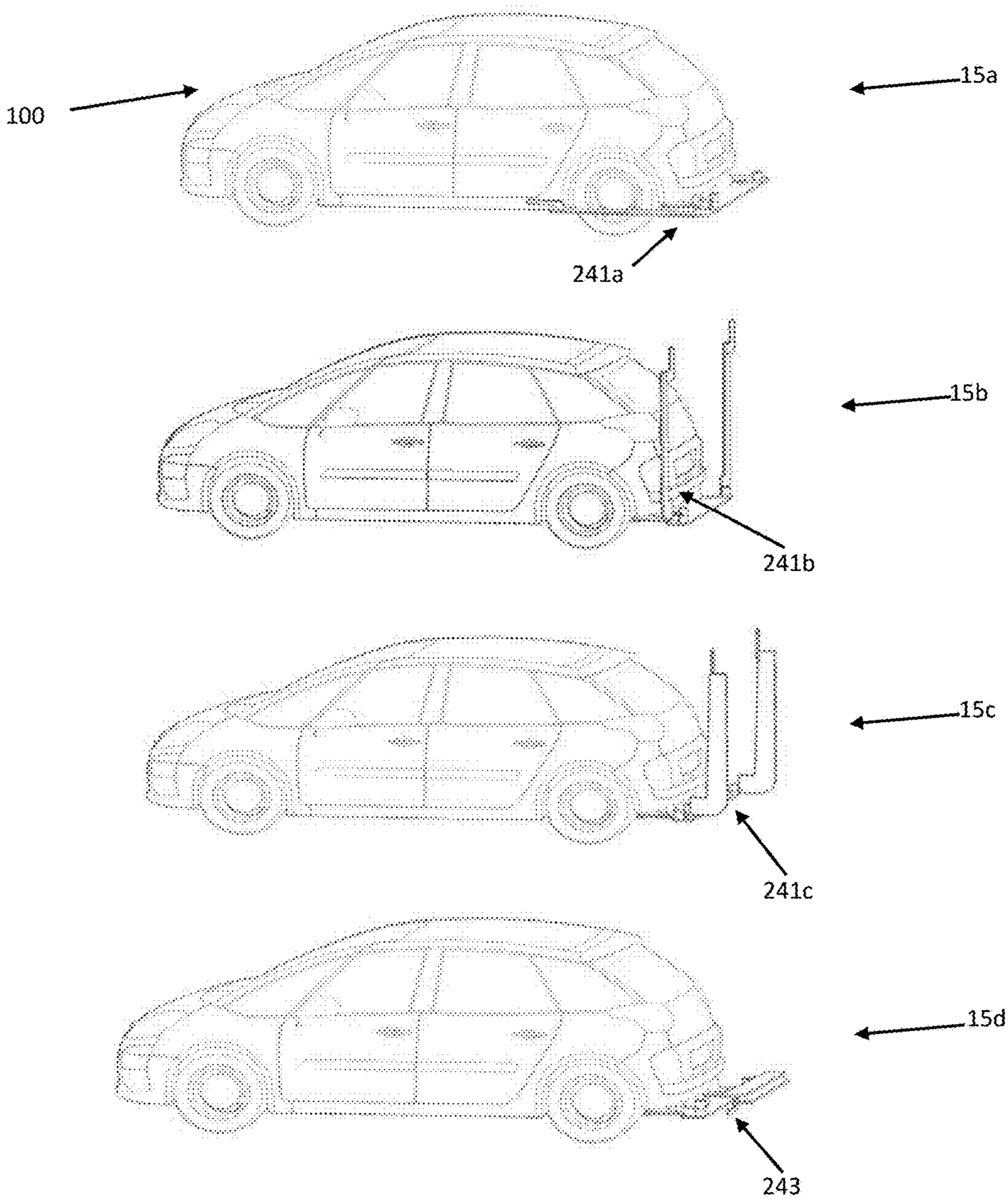

FIG. 15B

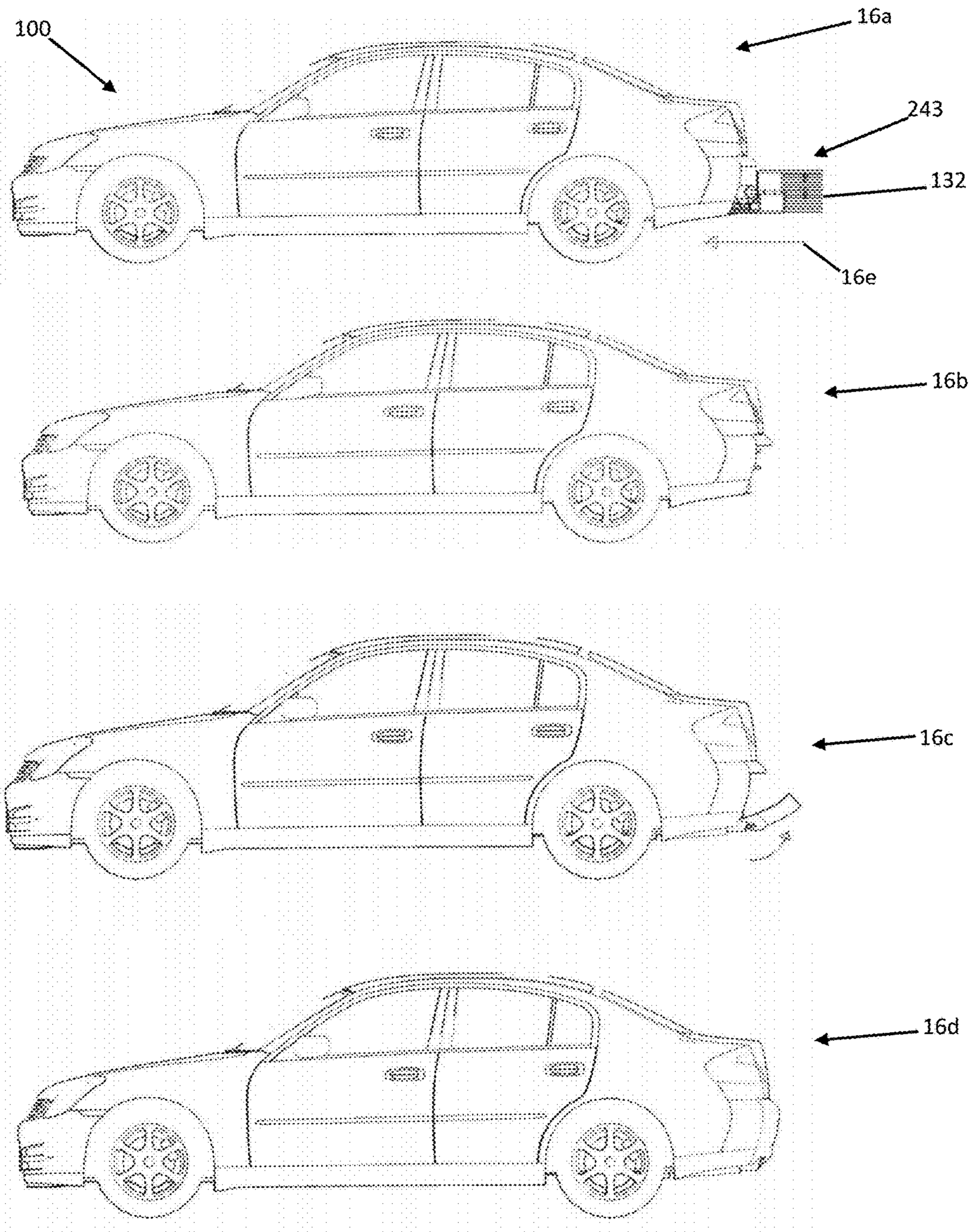

FIG. 16

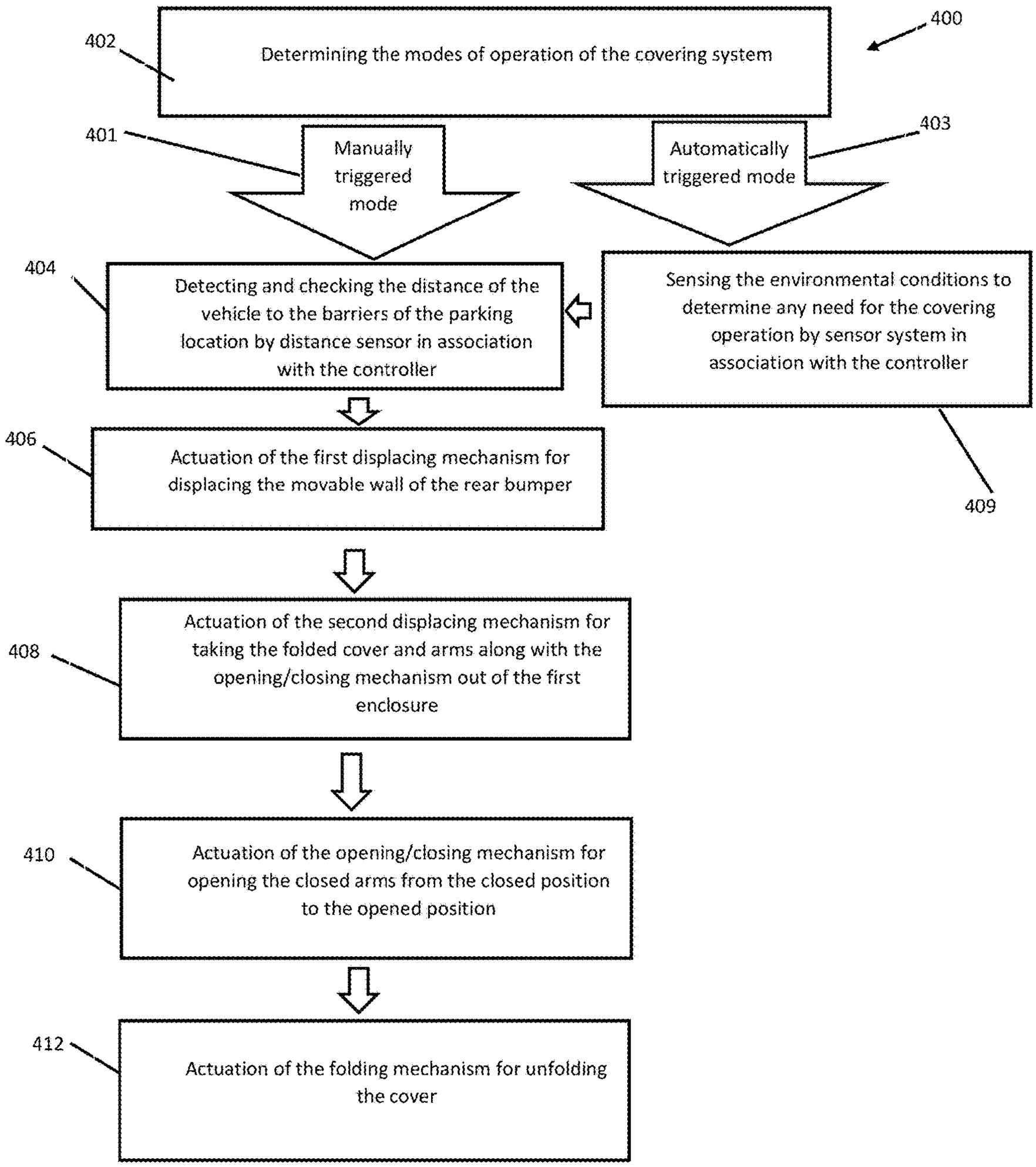
400
402
Determining the modes of operation of the covering system
401
Manually triggered mode
403
Automatically triggered mode
404
Detecting and checking the distance of the vehicle to the barriers of the parking location by distance sensor in association with the controller
Sensing the environmental conditions to determine any need for the covering operation by sensor system in association with the controller
409
406
Actuation of the first displacing mechanism for displacing the movable wall of the rear bumper
408
Actuation of the second displacing mechanism for taking the folded cover and arms along with the opening/closing mechanism out of the first enclosure
410
Actuation of the opening/closing mechanism for opening the closed arms from the closed position to the opened position
412
Actuation of the folding mechanism for unfolding the cover

FIG. 17A

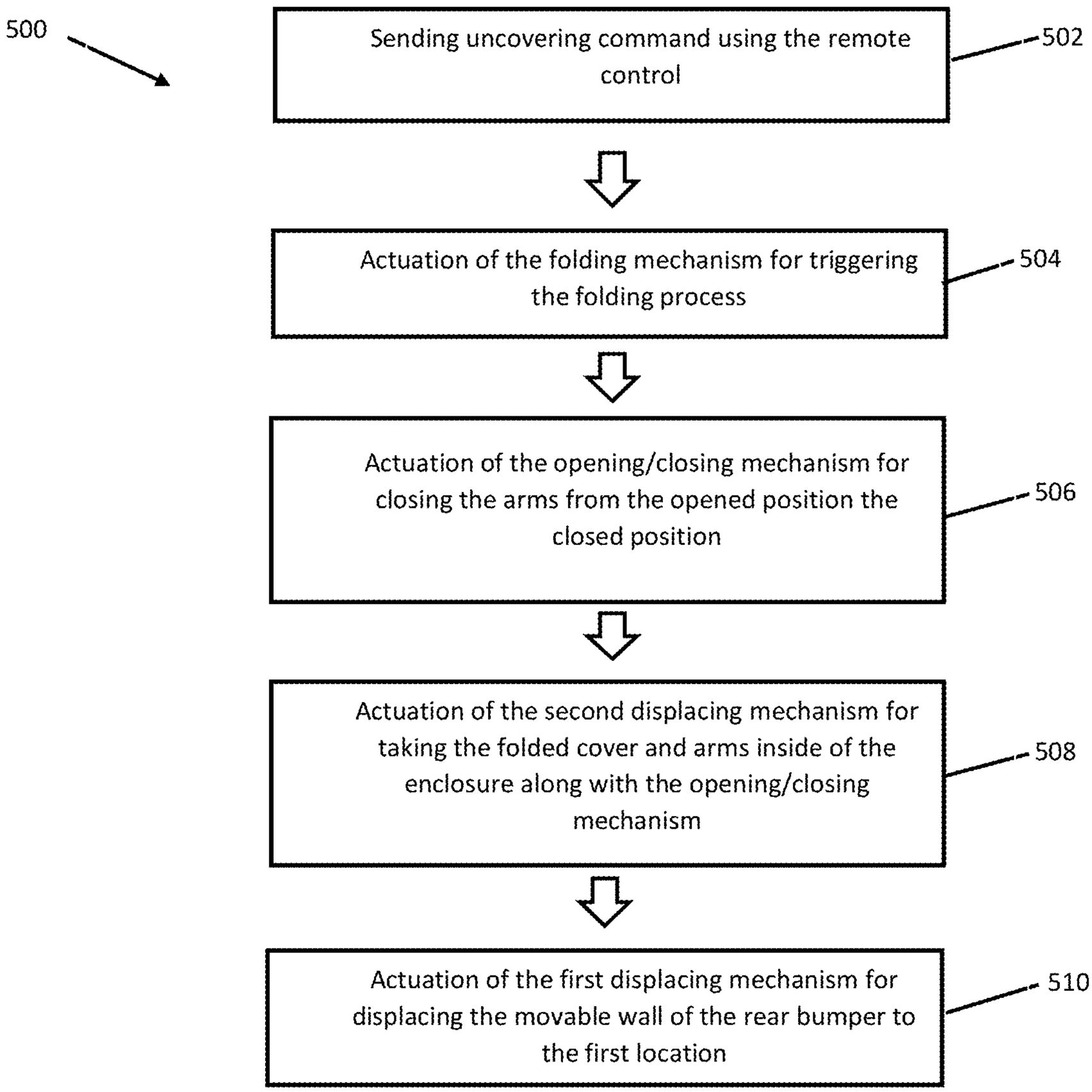
500
Sending uncovering command using the remote control
502
Actuation of the folding mechanism for triggering the folding process
504
Actuation of the opening/closing mechanism for closing the arms from the opened position the closed position
506
Actuation of the second displacing mechanism for taking the folded cover and arms inside of the enclosure along with the opening/closing mechanism
508
Actuation of the first displacing mechanism for displacing the movable wall of the rear bumper to the first location
510

FIG. 17B

AUTOMATIC VEHICLE COVER

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of priority from U.S. Provisional Patent Application No. 62/299,561, filed on Feb. 25, 2016, and entitled "FULLY AUTOMATED AND SMART FOLDING CAR COVER," which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

The present disclosure generally relates to systems and methods for covering of vehicles, particularly to systems and methods for automatic vehicle covering.

BACKGROUND

The protection of vehicles from paint degradation, corrosion, interior materials aging and color degradation may be considered as one of the main concerns of vehicle owners, which may force them to think about utilizing car covers to protect their vehicles from sunlight, rays, rain, snow, dust, etc. To this end, various types of covers have been introduced for various classes of vehicles including classic vehicles, mid-sized sedans, sport utility vehicles (SUVs), and compacts.

However, there is a need in the art for methods and devices for fully automatic vehicle covering without the need for manual intervention. There is further a need in the art for a smart method and device that allows for automatically covering a vehicle depending on the environmental conditions.

SUMMARY

Disclosed aspects include example systems and methods for automatic vehicle covering and examples may include a fully automatic and smart vehicle cover configured to provide protection for outer surface of a vehicle.

In an general aspect, the present disclosure describes a vehicle covering system, that may include: a cover that may have a first fold and a last fold; a first arm and a second arm, where a first portion of the first fold may be attached to an upper surface of the first arm and a second portion of the first fold may be attached to an upper surface of the second arm; an arm (opening/closing) mechanism that may be configured to open and close the first arm and the second arm; a folding mechanism that may be configured to fold and unfold the cover; and a control system that may be configured to cause the opening/closing mechanism to open the first arm and the second arm from a closed position to an opened position and cause the opening/closing mechanism to close the first arm and the second arm from an opened position to a closed position, and cause the folding mechanism to fold and unfold the cover when the first and the second arms are in an opened position.

According to an implementation, the covering system may further include an enclosure to enclose the cover, the first and the second arms, and the opening/closing mechanism therein. The enclosure may be a space defined inside the rear section of the vehicle and the rear section may include a part of the trunk and the hollow space inside the rear bumper. The rear bumper may include a movable wall that may be configured to be displaced from a first position to a second position. The first position may be on the rear bumper and the second position may be under the vehicle.

According to an implementation, the covering system may further include a first displacing mechanism to move the movable wall of the rear bumper from the first position to the second position. The displacing mechanism may include a motor having an output shaft, a converting mechanism coupled with the output shaft and an intermediate link attached to the movable wall of the rear bumper from one side and engaged with the converting mechanism from the other side. The converting mechanism may be configured to convert the rotational movement of the output shaft to a linear movement of the intermediate link.

According to an implementation, the covering system may further include a second displacing mechanism to displace the cover in a folded state, the arms and the opening/closing mechanism. The second displacing mechanism may be disposed within the enclosure and may include a movable mounting plate to allow for mounting the opening/closing mechanism thereon; and an actuating mechanism that may be coupled with the movable mounting plate and may be configured to displace the movable mounting plate in and out of the enclosure. The actuating mechanism may include a motor having an output shaft and a converting mechanism that may be coupled with the output shaft and may convert the rotational movement of the output shaft to a linear movement of the movable mounting plate.

According to an implementation, the opening/closing mechanism may include a first actuating mechanism and a second actuating mechanism. The first actuating mechanism may be pivotally coupled to a proximal end of the first arm to actuate the first arm to pivot about a first pivot point from a closed position to an opened position in an opening process and to pivot about the first pivot point from the opened position to the closed position in a closing process. The second actuating mechanism may be pivotally coupled to a proximal end of the second arm to actuate the second arm to pivot about a second pivot point from a closed position to an opened position in an opening process and to pivot about the second pivot point from the opened position to the closed position in a closing process.

In an implementation, the first actuating mechanism and the second actuating mechanism may include a hinge device having an upper leaf and a lower leaf and a central axis and a motor. The lower leaf may be fixed on the movable mounting plate and the upper leaf may be attached to a respective arm. The motor may be coupled with the central axis to rotate the respective arm.

According to an implementation, the hinge device may be replaced, for example, with a gearbox mechanism attached to the moveable mounting plate having an input shaft coupled with the motor and an output shaft pivotally attached to the proximal end of one of the arms.

In one implementation, the gearbox mechanism may include a housing, a bevel pinion-gear set, a first flat gear and a solenoid. The housing may include a fixed cylindrical container mounted on the movable mounting plate and fixed thereon to linearly displace therewith, and a rotatable cylindrical housing mounted coaxially on the fixed cylindrical container. The bevel pinion-gear set may rotate the respective arm and may include a driver bevel gear mounted on the input shaft and coupled with the motor and meshed with a driven bevel pinion to transmit the rotational power of the motor to the driven bevel pinion and freely displace along a shaft and a driven bevel pinion mounted on the output shaft and attached pivotally to the proximal end of the respective arm. The driven bevel pinion may be configured to transmit

the rotational power to the respective arm. The first flat gear may be coaxially attached to the upper surface of the driver bevel gear and rotatable therewith. The solenoid may be attached to the upper section of the rotatable cylindrical container and may be configured to engage and disengage the first flat gear with a second flat gear. The second flat gear may be attached to the solenoid coaxial with the first flat gear.

According to another implementation, the folding mechanism may include a container, a strip-like member placed inside the container from one end and attached to the last fold of the cover from another end and an actuator that may be configured to roll the strip-like member in and out of the container.

The actuator of the folding mechanism may include: a motor that may be configured to drive the strip-like member in and out of the container; a roller wheel that may be coupled with the motor, transversely placed on the strip-like member and force the strip-like member to move in a direct path; and a plurality of the rollers that may be placed on the strip-like member to straighten the path of the strip-like member.

According to another implementation, the strip-like member of the folding mechanism may be symmetrically attached to the last fold of the cover and may pass through the passage made by the transversal cords on the lower surface of the cover and carry the cover to be unfolded or folded.

In another implementation, the cover may include an accordion-pleated cover and the accordion-pleated cover may include a cover fabric, a plurality of transversal cords and at least two longitudinal cords. The cover fabric may have a plurality of folds, an upper surface and a lower surface. The plurality of transversal cords may be attached to the lower surface of the cover fabric and provide a guiding passage for the strip-like member to pass on the lower surface of the cover fabric. The longitudinal cords may be symmetrically attached to the lower surface of the cover fabric at either sides of the strip-like member.

According to another implementation, two equal lengths of either sides of the first fold of the cover may be attached to the upper surfaces of the first arm and the second arm.

In another implementation, the control system may cause the second displacing mechanism to displace the opening/closing mechanism, the first and the second arms and the cover in and out of the enclosure when the first and the second arms are in the closed position.

In another general aspect, the present disclosure describes a method for opening and closing a covering system. The method for opening the covering system may include: determining modes of operation of the covering system including an automatically triggered mode and a manually triggered mode. The automatically triggered mode may include: sensing the required environmental conditions for the covering system by a sensor system; and determining a need for activation of the covering system by a controller. The automatically triggered mode as well as the manually triggered mode may further include: checking distance of a vehicle to barriers of a parking location; activation of a first displacing mechanism for displacing a movable wall of a rear bumper from an initial location on a rear bumper to a secondary location; activation of a second displacing mechanism for taking a folded cover and arms along with an opening/closing mechanism out of an enclosure to a second position; activation of the opening/closing mechanism for opening closed arms from a closed state of the second position to an opened state of a third position; activation of a folding mechanism for unfolding a cover from a folded state in the third position to an unfolded state in a fourth position.

According to an implementation, the method for opening and closing the covering system may further include different positions, wherein the different positions may include: a second position wherein a folded cover and arms may be placed parallel to the rear bumper and the ground; a third position, wherein the arms may be opened and placed parallel to sides of the vehicle and the ground; and a fourth position, wherein the cover may be unfolded.

According to another implementation, the method for opening and closing the covering system may further include a method for closing the covering system, wherein the method for closing the covering system may include: sending an uncovering command to the controller using a remote control; activation of the folding mechanism for folding the cover from an unfolded state of the fourth position to a folded state in the third position; activation of the opening/closing mechanism for closing the arms from the opened state in the third position to the closed state in the second position; activation of the second displacing mechanism for taking the folded cover and arms along with the opening/closing mechanism inside the enclosure from the second position; and activation of the first displacing mechanism for displacing the movable wall of the rear bumper to the initial location on the rear bumper.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates different views of an exemplary vehicle showing different parts and accessories of the vehicle in association with a cover and its remote control, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **2** illustrates a schematic block diagram of one implementation of an exemplary covering system, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **3**A illustrates an exemplary folded cover and arms set along with an exemplary folding mechanism attached to the cover, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **3**B illustrates two different exemplary views of a cover in a fully opened state for an example of an accordion-pleated form, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **4**A illustrates an exemplary approximate position for mounting a first displacing mechanism and an exemplary approximate position for a locking mechanism in an exemplary vehicle, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **4**B illustrates an exemplary folded cover and arms in a position out of an enclosure and parallel to a rear bumper after being taken out of an enclosure.

FIG. **5** illustrates an example implementation of a first displacing mechanism for displacing an exemplary wall of a rear bumper, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **6** illustrates an example implementation of a second displacing mechanism for taking an exemplary folded cover and arms in and out of an enclosure and an example implementation of an opening/closing mechanism, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **7**A illustrates two exemplary positions of arms in an opening process in an exemplary vehicle with a specific

trunk as a rotational movement in an example implementation, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **7**B illustrates an exemplary implementation of an opening process of arms for an exemplary automatic vehicle cover in a vehicle without a specific trunk section showing different exemplary steps, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **8**A illustrates an schematic example implementation of an opening/closing mechanism for opening or closing exemplary arms along with a second displacing mechanism and a folding mechanism, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **8**B illustrates a top view of an example implementation of an opening/closing mechanism for rotationally opening or closing arms specific to a vehicle with a trunk, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **9**A illustrates sectional views of an example implementation of a gearbox mechanism through which the rotational movements of arms can be implemented in vehicles without a specific trunk section, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **9**B illustrates a perspective view of an example implementation of an opening/closing mechanism for a vehicle without trunk including an exemplary gearbox mechanism through which the rotational movements of arms can be implemented in vehicles without a specific trunk section, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **9**C illustrates schematic views of three exemplary consecutive rotational movements of arms in an exemplary opening process along with orientation of an exemplary gearbox mechanism in vehicles without a specific trunk section, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **9**D illustrates two schematic views of an example implementation of an opening/closing mechanism for rotationally opening or closing arms in vehicles without a specific trunk section, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **10** illustrates an example implementation of a folding mechanism configured to fold or unfold an exemplary cover by opening or rolling up an example implementation of a strip-like member, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **11**A illustrates three different example implementations of an accordion-pleated foldable cover having different types of folding, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **11**B illustrates three different example implementations of patterns along which an exemplary cover fabric may be folded, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **12**A illustrates an example implementation of an exemplary accordion-pleated cover consistent with one or more exemplary embodiments of the present disclosure.

FIG. **12**B illustrates schematic views of three example implementations of accessories associated with an exemplary accordion-pleated cover, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **13** illustrates a perspective view of an example implementation of a cover in a state of an exemplary closing process along with two schematic views of the cover in two different steps of the exemplary closing process.

FIG. **14** illustrates different views of an exemplary closing process of a cover, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **15**A illustrates two schematic views of two different positions of arms during an exemplary closing process of cover in vehicles with a specific trunk section, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **15**B illustrates schematic views of different positions of the arms during the closing process of the cover in vehicles without a specific trunk section, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **16** illustrates schematic views of four steps of an exemplary closing process from a position of exemplary closed arms to final locking of an exemplary movable wall of a rear bumper, consistent with one or more exemplary embodiments of the present disclosure.

FIG. **17**A illustrates a schematic flowchart of an exemplary opening process of an exemplary covering system, according to one or more aspects of the present disclosure.

FIG. **17**B illustrates a schematic flowchart of an exemplary closing process of an exemplary covering system, according to one or more aspects of the present disclosure.

DETAILED DESCRIPTION

Disclosed systems and methods herein are directed to a covering system, capable of covering outside surfaces of different kinds of vehicles, for example, different classes of vehicles like sedans, SUVs, vans, etc.

In an aspect, the present disclosure describes a covering system that may include a cover, a first arm and a second arm, an opening/closing mechanism (an arm mechanism), a folding mechanism and a control system.

FIG. **1** shows different schematic views of an exemplary vehicle **100**. The exemplary vehicle **100** may include a rear bumper **102**, a trunk (or any back section) **104**, vehicle flashers **108**, a reverse gear light **110**, a speaker **114**, a battery **112**, side mirrors **107**, etc. The exemplary vehicle **100** may also include some other parts and accessories like a distance sensor **122** configured to measure the distance, a light sensor **120** configured to measure the intensity of sunlight, a temperature sensor **111**, a humidity sensor **113**, and a controller **302**. There may be a specific space as an enclosure **106** bounding inside of the rear bumper **102** and a portion of the trunk **104**, which is shown as a dashed-line area. The enclosure **106** may provide a space for placement of specific parts and mechanisms related to an exemplary covering system.

The covering system disclosed herein, may be activated either manually by a user or automatically by a control system. The cover may undergo an opening process or a closing process. In the opening process, the cover may be taken out of the enclosure where it unfolds to cover the outer surface of a vehicle. In a closing process, the cover may fold from an opened position to a folded position, thereby become placed inside the enclosure. The opening and closing processes may be controlled by the control system.

FIG. **2** is a schematic block diagram of one implementation of an exemplary covering system **300** according to one or more aspects of the present disclosure. The covering system **300** may include a cover set **306**, an actuating system **303** and a control system **308**. The control system **308** may include a remote control **301**, a controller **302** and a sensor system **304**. The cover set **306** may include the movable wall of the rear bumper **306***a*, the folded cover and arms **306***b*, the arms **306***c* and a cover **306***d*.

The actuating system **303** may generally cause the different elements of the cover set **306** to be operated. The actuating system **303** in one exemplary implementation may include: a first displacing mechanism **303***a*, a second displacing mechanism **303***b*, an opening/closing actuating mechanism **303***c*, and a folding mechanism **303***d*.

In one implementation, the cover may include an accordion-pleated cover. The cover may have the capability of folding or unfolding along accordion-like patterns. The cover may include a cover fabric, a plurality of transversal cords attached to the lower surface of the cover fabric and at least two longitudinal cords symmetrically attached to the lower surface of the cover fabric. The cover fabric may have a plurality of folds, an upper surface, and a lower surface.

In some implementations, the cover **306***d* in a folded state may be housed inside a specified space, for example, the enclosure **106** in FIG. **1**. The cover **306***d* may be taken out of the enclosure **106** and unfolded in order to cover an outside surface of an exemplary vehicle.

In one exemplary implementation the enclosure **106** may be bounded to a portion of lower side of the trunk **104** and/or inside part of the rear bumper **102**. The enclosure **106** may be also an external housing, which may be attached to the vehicle **100** (FIG. **1**).

In a state in which the cover **306***d* is placed in the enclosure **106**, a back wall **306***a* of the rear bumper may be configured to be movable. A first fold of the cover **306***d* may be attached to upper surfaces of two pivotally rotatable arms **306***c*. The cover may have an opened position when the cover is wrap the vehicle and a folded position when placed on the arms **306***c*.

The set of the remote control **301**, the controller **302** and the sensor system **304** may collectively form the control system **308**. The control system **308** may control any movements of the covering system **300** and control decisions regarding sequential actuations of mechanisms, sensing of the ongoing conditions regarding the inside actuations, or sending external conditions utilizing data exchanged between it and the actuating system **303** and the sensor system **304**.

The remote control **301** may directly send data to the controller **302**. A user may press a manual tab on the remote control **301**, to manually trigger the covering system **300**. Alternatively, the covering system **300** may be automatically triggered to open based on a determination and a command from the control system **308**. In an exemplary embodiment, the automatic functionality may be triggered by pressing the auto tab of the remote control **301**.

In the automatic mode, the outside sensing system **304***a* may determine if a set of required conditions are satisfied to force the covering system **300** to be activated or opened by the controller **302**. The environmental conditions may include intensity of sunlight, temperature, humidity, in addition to other outside weather condition which may be sensed by sensors such as respective sunlight sensor **120**, temperature sensor **111** and humidity sensor **113** to determine if there is any need for the covering system **300** to be activated. Also, the allowable distance of the vehicle **100** from side barriers may be sensed by a distance sensor **122** to be greater from a predefined distance to allow the covering system **300** to be activated. The controller **302** may trigger the covering system **300** upon receiving the signal from the distance sensor **122** indicating the allowable and needed distance exists.

The sensor system **304** may include an outside sensing system **304***a* (receiving input data from outside of the covering system **300**) and an inside sensing system **304***b* including different sensors specified to each of the actuating mechanisms, separately. The outside sensing system **304***a* may include the light sensor **120**, the humidity sensor **113** and the temperature sensor **111** along with the distance sensor **122**. The outside sensing system **304**A may be configured to provide the controller **302** with the data from the ongoing environmental conditions. The sent data to the controller **302** may be used as a base for the controller **302** to activate the covering system **300**.

Also, the distance of the rear bumper **102** from the side barriers may be detected and sent to the controller **302** by a distance sensor of the outside sensing system **304***a*. The existence minimum distance may be checked to in order to take the folded cover and arms **306***b* out of the enclosure **106** without causing a collision. The controller **302** may use the feedback received from the outside sensing system **304***b* to decide whether the folded cover and arms **306***b* may be opened and taken out of a box. The inside sensing system **304***b* may include sensors which are associated with each of the actuating mechanisms in order to inspect and regulate the functionality of the actuating mechanisms.

The controller **302** may provide the required control signals for either actuation or sensing in a successive and timely manner. The controller **302** may include a memory **302***a* for storing the received data and a processor **302***b* for processing the received data and producing control signals. The input data which may be received from the sensor system **304** or the remote control **301** may be stored in the memory **302***a* and serve as an input for the processor **302***b*. The processor **302***b* may be configured to process the data received and produce the control signals for the subsequent actuating system **303**. The processor **302***b* may send control signals to the mechanisms of the actuating system **303** and also the sensors of the sensor system **304** sequentially.

A number of different mechanisms may be configured to actuate respective parts of the covering system. The control system may determine the timing and sequence of the actuations.

In one exemplary implementation, the actuating system **303** may include the first displacing mechanism **303***a*, the second displacing mechanism **303***b*, the opening/closing mechanism **303***c* and the folding mechanism **303***d*. All mechanisms of the actuating system **303** may be activated to deliver a specific functionality under the control of the control system **308**.

The first displacing mechanism **303***a* may be configured to displace the movable wall of the rear bumper **306***a* from a first position, for example, on the rear bumper **102** to a second position, for example, under the bottom of the vehicle **128** to allow for the displacement of the cover **306***d* in its folded state as described below.

The second displacing mechanism **303***b* may be configured to linearly displace the folded cover and arms **306***b* from a first position inside the enclosure **106** to a second position outside the enclosure **106**. The second position may be, for example, a position parallel to the rear bumper **102** and the ground. The second displacing mechanism **303***b* may be also configured to displace the opening/closing mechanism **303***c* along with the folded cover and arms **306***b* in order to be able to perform opening and closing functionality.

The opening/closing mechanism **303***c* may be configured to enable the arms **306***c* in the closed state to pivotally rotate around a connecting line or point in one rotation or a set of three successive rotations and the folding mechanism **303***d* may be configured to fold or unfold the cover **306***d*.

During an opening process, the control system **308** may activate respective mechanism of the actuating system **303** to take the required operation under the regulatory inspection of the respective sensors of the inside sensing system **304***b*. In one step, the first displacing mechanism **303***a* for displacing the movable wall of the rear bumper **306***a* may be actuated. As a result, the movable wall **306***a* may be placed under the bottom of the vehicle **100**. Then, the controller **302** may enforce the second displacing mechanism **303***b* to take the folded cover and arms **306***b* out of the enclosure **106**. As a result the folded cover and arms **306***b* may be placed in the second position parallel to the rear bumper and the ground. Then, the opening/closing mechanism **303***c* may be actuated to pivotally open the arms **306***c* in a defined timely manner. In this step, the arms **306***c* may be placed parallel to either sides of the vehicle **100** and the ground after the movement. After the opening of the arms **306***c*, the cover **306***d* may be placed in a position which enables the cover **306***d* to take the unfolding process. In another step, the folding mechanism **303***d* may be actuated by the control system **308** to trigger the unfolding operation of the cover **306***d*. If the opening process is not be paused, for example, through pressing the respective tab on the remote control **301**, the cover **306***d* may be unfolded fully to wrap whole the outer surface of the vehicle **100**. The process for a closing operation may be performed in a reverse steps, which means that all mechanisms may be summoned in successive reverse steps, which is discussed later in this disclosure in further detail.

FIG. **3**A shows an exemplary implementation of the folded cover and arms set **306***b* along with an exemplary folding mechanism **303***d* attached to the cover **306***d*. According to FIGS. **1** and **3**A, the cover **306***d* is attached to the arms **134***a* and **134***b*. The cover **306***d* in its folded state along with the arms **134***a* and **134***b* in their closed state may form a set, which may be named the folded cover and arms **306***b* and located inside the enclosure **106**. The enclosure **106** may be configured to hold the folded cover and arms **306***b*. The cover **306***d* in its folded state may be placed in the enclosure **106**, when the vehicle **100** is running or at the onset of starting, or when the control system **308** determined that the covering system **300** should not be triggered. When the vehicle **100** is stopped in a parking location and there is no other movement in the position of the vehicle **100**, the control system **308** may determine if there is any need for the covering system **300** to be triggered and provide means for performing either the opening process **400** (as shown in FIG. **18**A) or closing process **500** (as shown in FIG. **18**A) of the covering system **300**.

In embodiments, covering system **300** may operate in an automatically triggered mode or in a manually triggered mode. In order for the cover **306***d* to be activated into the covering operation in a fully automatic manner, a determination may be made regarding outside environmental conditions, e.g. sunlight intensity, temperature and humidity. The outside conditions of the vehicle **100** may include determining whether it is rainy, snowy, with excessive sunlight, highly humid or the like. The temperature sensor **111**, the humidity sensor **113** and the light sensors **120** may be considered as exemplary implementations of some of the sensors of the outside sensing system **304***b*. If the temperature, humidity or sunlight intensity are determined by the sensors to be greater than a certain range representing threshold values, then the controller **302** may trigger the opening process **400** of the covering system **300**. Light sensors **120** and temperature sensors **111** may be stimulated by the excessive sunlight intensity and the extreme temperature and the humidity sensor **113** may be stimulated by high humidity that occurs before and during rain, snow and so on. If the control system **308** is set on the automatically triggered (auto) mode through the remote control **301**, the covering system **300** may be triggered to operate through a stimulating signal receiving from one of these sensors. Also, if the control system **308** is set on the manually triggered (manual) mode using the remote control **301**, the covering system **300** may be activated upon receiving a signal from the remote control **301** decided by user.

Referring to FIGS. **1** and **2**, before conducting the opening process **400**, the minimum distance of the vehicle **100** from barriers in parking location may be determined. If the distance is greater from a predefined value, the controller **302** may trigger the opening process **400**. The distance sensor **122** may be considered as an example implementation of a sensor of the outside sensing system **304***a*. In one example implementation the distance sensor **122** may be mounted on the rear bumper **102** of the vehicle **100** to sense the distance of the rear bumper **102** from the backside barrier. Such a minimum distance may be required for the folded cover and arms **306***b* to come out of the enclosure **106** without collision.

After ensuring that there is a minimum allowable distance outside of the rear bumper **102**, the control system **308** may provide a series of consecutive signals for a number of different mechanisms of the actuating system **303**. The cover **306***d* in its folded state which is attached to the arms **134***a* and **134***b*, may be forced to come out of the enclosure **106**. In this state the flashers **108** may be allowed by the control system **308** to be turned on. Also, a warning alarm may be played by the controller **302** through the vehicle's speaker **114** to keep people informed of the process.

Referring to FIG. **1**, if the distance, between the vehicle **100** and barriers in the parking location, is distinguished by the control system **308** to be less than a required minimum value, then the controller **302** may notify the driver. In this state, an alarm may be played and the reverse gear lights **110** may be turned on and made to flash so that the driver is signaled to that the opening process **400** may not be operational due to the short distance. After changing the location of the vehicle **100** in a way that the minimum distance regulation is complied with, the controller **302** may allow the opening process **400** to be triggered either manually or automatically. The electric current required for electronic systems, the control systems **308** and different mechanisms of the actuating system **303** may be produced by a battery **112** that may work individually or along with the vehicle's battery.

When the cover **306***d* is in a fully opened state, the controller **302** may cause the movement of the cover **306***d* and the playing of warning alarm through the speaker **114** to be stopped. The flashers **108** of the vehicle **100** may be also turned off. In this state, the controller **302** may be in a standby mode. It means that it is possible to trigger activation of the closing process **500** by the control system **308** upon the user's request using the remote control **301**.

FIG. **3**B, illustrates two views of the cover **306***d* in a fully opened state. The cover **306***d* may have an accordion-pleated form which may be formed based on a pre-defined pattern facilitating the folding and unfolding processes. During the opening process **400**, folds **136** of the cover **306***d* may be opened along a longitudinal axis **131** of the vehicle **100**. When the cover **306***d* fully wrap the vehicle **100**, it may appear as a hollow accordion shaped box which protects all sides of the body of the vehicle **100**, which is mounted on the arms **134***a* and **134***b* on either sides of the vehicle **100** and on movable guiding devices **240**. The movable guiding

devices **240** may be mounted on either sides of the front section of the cover **306***d* facilitating the movements of the cover **306***d* during the opening process **400** or closing process **500**.

Referring to FIG. **4**B, when the folded cover and arms **306***b* are taken out of the enclosure **106**, they may be placed parallel to the rear bumper **102** and the ground as a folded set. The folded cover and arms **306***b* may be displaced linearly along the longitudinal axis **131** of the vehicle **100**, shown in FIG. **3**B, through an actuation caused by the second displacing mechanism **303***b*. The controller **302** may force the second displacing mechanism **303***b* to either actuate the process of taking the folded cover and arms **306***b* out of the enclosure **106** or inside the enclosure **106**.

FIG. **5** shows one exemplary implementation of the linear first displacing mechanism **303***a* configured to displace the movable wall of the rear bumper **306***a*. This mechanism may be able to deliver a linear output movement along the longitudinal axis **131** of the vehicle **100**. The output of the first displacing mechanism **303***a* may be attached to the movable wall of the rear bumper **306***a*. The displacement course of the first displacing mechanism **303***a* may be defined between a first position of the movable wall of the rear bumper **306***a* on the rear bumper **102** and a second position of the movable wall of the rear bumper **306***a* under the bottom **128** of the vehicle **100**. In the second position, the movable wall of the rear bumper **306***a* may be placed under the bottom **128** of the vehicle **100** in the opening process **400**. In the closing process **500** the displacement positions may be reversed from the second position to the first position. The displacement course and successive actuations of the first displacing mechanism **303***a* may be controlled by the control system **308**.

Referring to FIG. **5**, the first displacing mechanism **303***a* may include a rotary actuator **142**, a converting mechanism **144**, and an intermediate link **146** attached to the movable wall of the rear bumper **306***a* from one side and engaged with the converting mechanism **144** from the other side. The first displacing mechanism **303***a* may further include a set of two parallel guiding rails **150** that may be mounted on the bottom of vehicle **128** at either sides of the link **146** defining the required path for the movements of the link **146**, two location sensors **152** that may be placed at either sides of the displacement course of the movable wall **306***a* to inspect the displacement to be in the defined range.

In some implementations, the rotary actuator **142** may include a motor **142***a* and its associated gearbox **142***b* and may be mounted on the bottom **128** of the vehicle **100** to provide the required rotational power and transmission for displacing the movable wall of the rear bumper **306***a*.

In an exemplary implementation, the converting mechanism **144** may be coupled with the output shaft of the rotary actuator **142** at one end and rotatable therewith and coupled with the intermediate link **146** at the other end, converting the rotational power and displacement to the linear power and displacement. The converting mechanism **144** may be in the form of a set of a threaded rod **144***a* engaged with a nut or a ball screw assembly. In the former form, the nut may be mounted under the bottom of the intermediate link **146**, causing the intermediate link **146** to linearly displace as the threaded rod **144***a* linearly moves.

In some implementations, the intermediate link **146** may be placed between the converting mechanism **144** and the moveable wall of the rear bumper **306***a*. The intermediate link **146** may move linearly with the output of the converting mechanism **144**. The intermediate link **146** may receive and transmit the power and linear displacement from the converting mechanism **144** to the movable wall of the rear bumper **306***a* and cause the movable wall of the rear bumper **306***a* to displace. The intermediate link **146** may act as a linkage element which may be connected to the movable wall of the rear bumper **306***a* by a hinge **148** and a spring **149**. A link **147** may be located as a connecting linkage between the intermediate link **146** and the movable wall of the rear bumper **306***a*. The hinge **148** may be configured to transmit the power to the movable wall of the rear bumper **306***a* and cause a change of direction in its displacement course from a linear path to a curved path and vice versa. The spring **149** may be configured to provide the required restoring force. When the controller **302** activates the first displacing mechanism **303***a* to displace the movable wall of the rear bumper **306***a*, one of the sensors **152** may sense the displacement course in the opening process **400** to be in the defined range and another sensor **152** may sense the movement of the intermediate link **146** in the reverse displacement. The sensors **152** may determine the end of displacement and inform the controller **302** from the end of displacing operation.

The motor **142***a* may be configured to start rotating after receiving the activating signal from the controller **302**, sending the power to a threaded rod **144** through the output shaft of a gearbox **142***a* and causing the threaded rod **144** to rotate therewith. The threaded rod **144***a* engaged with a nut may convert a rotational movement of the motor **142***a* to a linear movement of the intermediate link **146** along the path defined by guiding rails **150**. A ball screw assembly also may be configured as another example implementation of the converting mechanism **144**. The moveable wall of the rear bumper **306***a* is connected with the intermediate link **146** by attachment to the hinge **148** and the spring **149** and a connecting link **147**, may be forced to displace accordingly therewith.

Referring to FIGS. **5** and **4**A, in one exemplary implementation, the first displacing mechanism **303***a* may be placed under the bottom **128** of the vehicle **100**. The fixed parts of the mechanism **140** may be mounted on the bottom **128** of the vehicle **100** and a casing **153** may be placed thereon. Also, it is possible to mount the elements in an external housing box, which may be mounted in the vehicle **100**.

FIG. **6** shows the second displacing mechanism **303***b* for linearly displacing the folded cover and arms **306***b* outside or inside of the enclosure **106**. After opening the movable wall of the rear bumper **306***a*, the controller **302** may force the linear second displacing mechanism **303***b* to take the folded cover and arms **306***b* out of the enclosure **106**. In one exemplary implementation, this mechanism may include a movable mounting plate **162** configured to undergo linear movement between a first position and a second position, a set of two guiding rails **164** mounting at either sides of the enclosure **106** parallel to the longitudinal axis **131** of the vehicle **100** defining a path for the displacement of the movable mounting plate **162**, a motor **166** providing the power for displacing the movable mounting plate **162** mounted on the bottom of the enclosure **106** without any direct attachment to the movable mounting plate **162**, a converting mechanism **167** configured to convert the rotational output motion of the geared motor **166** to a linear displacements in the movable mounting plate **162**, two location sensors **172***a* and **172***b*, mounted at either sides of the converting mechanism **167** configured to sense the displacement of the movable mounting plate **162** to be in a certain range allowing the displacement to be performed between the first position and the second position.

In one exemplary implementation, the converting mechanism **167** may be considered to be a set of rack **168** and pinion **170** gears, wherein the pinion gear **170** coupled with the output shaft of the motor **166** and rotatable therewith engaging with the rack gear **168**. The rack gear **168** may be mounted on the movable mounting plate **162** along the longitudinal axis **131** of the vehicle **100**. The pinion gear **166** may drive the rack gear **168**. The rack gear **168** which is attached to the movable mounting plate **162** may be displaced linearly outward or inward of the enclosure **106**, causing the movable mounting plate **162** to be taken outside or inside of the enclosure **106**, therewith. Two appendages **174***a* and **174***b*, mounted at the end of the displacement course of the movable mounting plate **162**, may be configured to determine the allowable displacement course for the sensors **172***a* and **172***b*. The sensors **172***a* and **172***b* may also inform the controller **302** of the fully extracting the folded cover and arms **306***b* from the enclosure **106** in the opening process **400** or fully taking the folded cover and arms **306***b* inside the enclosure in the closing process **500**. The data from the sensors **172***a* and **172***b* may be sent to the controller **302** in order to determine the next control decision by the controller **302**.

In one implementation, the second displacing mechanism **303***b* may be located in an enclosure, for example, either exemplary enclosure **106** (or another enclosure) which allows the folded cover and arms **306***b* along with the opening/closing mechanism **303***c* to be linearly taken in or out of the enclosure **106**. In one exemplary implementation shown in FIG. **6**, the rack gear **168** may be attached to the movable mounting plate **162**. The folded cover and arms **306***b* may be attached to the output of the opening/closing mechanism **303***c*. The opening/closing mechanism **303***c* may be attached to the movable mounting plate **162** and placed inside the enclosure **106**. Thus, the movable mounting plate **162** and the rack gear **168** may be also placed inside the enclosure **106**. The activation and actuations of the second displacing mechanism **303***b* may be controlled by the control system **308**.

After taking the folded cover and arms **306***b* out of the enclosure **106**, it may be in a position parallel to the rear bumper **102** as shown in FIG. **4**B. In this position, the arms **134***a* and **134***b* may be placed in a first position, wherein the arms **134***a* and **134***b* may be in a closed state parallel to the rear bumper and the ground, lying on each another. The cover **306***d* in its folded state may be attached to the arms **134***a* and **134***b* in this position. The arms **134***a* and **134***b* may be opened from this position, thereafter as part of an exemplary opening process **400**. The second position of the arms **134***a* and **134***b* may be defined as a state parallel to either sides of the vehicle **100** and the ground.

The opening process **400** of the arms **134***a* and **134***b* may be activated by the control system **308** using the opening/closing mechanism **303***c* configured to open or close the arms **134***a* and **134***b* in the folded cover and arms **306***b* from their first position to their second positions. The arms **134***a* and **134***b* may be opened or closed subsequently one after another in a way to avoid collision of the arms **134***a* and **134***b*.

The procedures for the opening or closing are different for the vehicles **100** with the specific trunk **104** which are mostly the vehicles **100** in sedan class and the vehicles in other different classes like SUVs, vans, wagons, hatchbacks, etc., without having a specific trunk **104**. For example, in sedan class of the vehicles **100**, the opening and closing of the arms **134***a* and **134***b* may be performed in one rotational movement around a pivot. The pivot may be defined by the point of connection of the arms **134***a* and **134***b* to their respective opening/closing mechanism **303***c*. The axis of rotation of each arm **134***a* or **134***b* makes a 45-degree angle relative to the horizontal axis, in other classes of the vehicles **100**, the opening and closing of the arms **134***a* and **134***b* may be performed in a set of three successive rotational movements controlled by the control system **308**. Upon undergoing the opening process, the arms **134***a* and **134***b* in the opened state along with the cover **306***d*, which is still folded, may appear as a U-shaped set forming around the backside of the vehicle **100**, allowing for the cover **306***d* to be unfolded. The U-shaped form of the arms **134***a* and **134***b* in the opened state are shown in FIGS. **7**A and **7**B.

Referring to FIGS. **6**, **7**A and **8**A, in an exemplary sedan class of the vehicles **100**, each one of the arms **134***a* and **134***b* may open or close in a rotational movement around a pivotal line of connection shown as an axis **181***a* or **181***b* making a 45-degree angle with the horizontal axis **181***c*. The arms **134***a* and **134***b* may rotate around the axis **181***a* or **181***b* in order to relocate from the first position parallel to the rear bumper and the ground to the second position parallel to the sides of the vehicle **100** and the ground as a part of the opening process **400** of the covering system **300**.

Two sets of the opening/closing mechanism **303***c* shown in FIGS. **8**A and **8**B may be configured for opening and closing the arms **134***a* and **134***b*. Referring to FIG. **8**A, in one exemplary implementation, each one of the opening/closing mechanism **303***c* may include motors (or geared motor) **184***a* or **184***b*, providing the required power for the rotational movement, each one coupled with the respective arms **134***a* or **134***b*, two hinges **188***a* and **188***b*, each attached to the movable mounting plate **162** and also to the respective arms **134***a* and **134***b*, transmitting the rotation of the motor **184***a* or **184***b* to the arms **134***a* and **134***b* causing to the arms **134***a* and **134***b* to rotate, a sensor **186***a* or **186***b* configured to sense the rotational displacement of the arms **134***a* and **134***b* mounted on the output of the motor **184***a* or **184***b*. The motors **184***a* and **184***b* may be mounted on the movable plate **162** and linearly movable therewith with the mounting orientation in which the output shaft of the geared motor **184***a* or **184***b* may be placed in line with the axis of rotation **181***a* or **181***b*. The geared motor **184***a* or **184***b* may be connected to the arms **134***a* or **134***b* using respective hinges **188***a* or **188***b*.

Each one of the hinges **188***a* or **188***b* may include a central axis **189***a* or **189***b* and two leaves **191***a* and **195***a* or **191***b* and **195***b*. Each one of the hinges **188***a* or **188***b* may be coupled with the output of the respective motor **184***a* or **184***b* through the central axis **189***a* or **189***b* to the output of the motor **184***a* or **184***b* and rotatable therewith. The lower leaf of each hinge **191***a* or **191***b*, is mounted on the movable mounting plate **162** and the upper leaf of each hinge **195***a* or **195***b*, may be attached to a proximal end **139***a* of the respective arms **134***a* or **134***b*. The rotational displacement of the arms **134***a* or **134***b* may be performed around this attaching line.

Referring to FIG. **6**, when the respective sensor **172***a* on the moveable mounting plate **162** of the second displacing mechanism **303***b* send a signal to the controller **302** determining full extraction of the folded cover and arms **306***b* from the enclosure **106**, the controller **302** may activate the geared motors **184***a* and **184***b* to rotate a predefined direction shown by arrows **183***a* and **183***b* in FIG. **6**. In this state, the motors **184***a* and **184***b* may be displaced outside of the enclosure **106**. As a result of the rotation of the motors **184***a* or **184***b* the attached hinge **188***a* or **188***b* may also rotate due to rotation of its central axis **189***a* or **189***b* which is coupled with the output shaft of the motor **184***a* and **184***b*. The

hinge's upper leaf **195***a* and **195***b* may rotate accordingly, through which the attached arms **134***a* or **134***b* may also be rotationally displaced. As a result, the arms **134***a* and **134***b* may rotate around the axis **181***a* and **181***b* and may be displaced from the first position to the second position of the arms **306***b*. The sensors **186** may sense the rotation of the arms **134***a* or **134***b* and inform the controller **302** of the angle of rotation of the motor **184***a* and **184***b*. One of the arms **134***a* or **134***b* may be lie on the other arm **134***a* or **134***b* in the folded position. After beginning the opening procedure for the first arm **134***a* or **134***b*, the second arm **134***a* or **134***b* may start opening after a specific time delay set by the control system **308**. It means one of the opening/closing mechanisms **180***a* or **180***b* may be activated before the other one **180***a* or **180***b*.

Referring to FIG. **9**D, the arms **134***a* and **134***b* may have a proximal end **139***a*, a distal end **139***b*, and an upper surface **139***c*. The proximal end **139***a* may be attached to hinge devices **188***a* or **188***b* or to the output shaft **194***b* of a gearbox mechanism **194**. The connecting point **193** may be used as a pivot for rotation of the arms **134***a* and **134***b*. The first fold **136***a* of the cover **306***d* may be attached to the upper surface **139***c* of the arms **134***a* and **134***b*.

Referring to FIG. **7**B, the opening and closing procedures of the arms **134***a* and **134***b* in the vehicles **100** without a specific trunk may be different compared with sedan class of the vehicles **100**. Each arm **134***a* or **134***b* may undergo a series of three successive rotational movements. The arm **134***a* or **134***b* which is placed at the top may be first triggered by the controller **302** to take the opening action ahead of the other arm **134***a* or **134***b*. A coordinating system may be defined by a set of mutually perpendicular axes **103***a*, **103***b* and **103***d*. The origin of this coordinate system may be placed at the point **103***o* attached to the pivotal connecting point **193**. The axis **103***a*, may be parallel to the longitudinal axis **131** of the vehicle **100**, also known as roll axis. The axis **103***b*, may be parallel to the axis perpendicular to the ground, also known as yaw axis. The axis **103***c*, may be parallel to the transversal axis of the vehicle **100**, also known as pitch axis. The axes **103***a*', **103***b*' and **103***d*' may be parallel to axes **103***a*, **103***b* and **103***d*, respectively passing through the pivotal connecting point **103***o*'. The points **103***o* and **103***o*' may be respectively attached to the pivotal connecting points **193** of the proximal ends **139***a* of the arms **134***a* and **134***b* to the movable mounting plate **162**. In state **100***a*, the folded cover and arms **306***b* may be parallel to the back of the rear bumper **102** after being taken out of the enclosure **106**. The first rotational movement may be performed around the axis **103***a* along the arrow **103***d*. As a result the arms **134***a* or **134***b* may be placed in the position **100***b* perpendicular to the ground. The next step may be a rotational movement around the axis **103***b*, in a direction shown by arrow **103***e*, causing the arms **134***a* and **134***b* to place in a position shown in state **100***c*. Then the next rotational movement may be done around the axis **103***c* in a direction shown by arrow **103***f*, causing the arms **134***a* and **134***b* to take the shape shown in state **100***d*. After undergoing the whole opening process the arms **134***a* and **134***b* in the opened state and the cover **306***d* in its folded state may take a U-shaped form. In the closing process of the arms **134***a* and **134***b* the explained procedure may be performed in a reverse direction.

The opening of the arms **134***a* and **134***b* in the non-sedan class of the vehicles **100** may be performed by another opening/closing mechanism **190** which may allow the arms **134***a* and **134***b* to undergo three successive rotational movements. The opening/closing mechanism **190** shown in FIG. **9**D may be considered as another example implementation of the opening/closing mechanism **303***c* of FIG. **2**. The opening/closing mechanism **190** may include a rotary actuator **197**, which may include a geared motor **192**, configured to provide power for rotational movements of the arms **134***a* and **134***b*, mounted on the movable mounting plate **162**; and a gearbox mechanism **194**, having an output shaft **194***b* and an input shaft **194***a* coupled with an output shaft **194***a* of the geared motor **192** and may be configured to provide the arms **134***a* and **134***b* with three successive rotational movements. The gearbox mechanism **194** may be mounted on the movable mounting plate **162** and movable therewith. The output shaft **194***b* of the gearbox mechanism **194** may be attached to the proximal end **139***a* of the respective arm **134***a* or **134***b*. The gearbox mechanism **194** may be taken in or out of the enclosure **106**, so that it may be activated by the controller **302** to open or close the arms **134***a* and **134***b*. The control system **308** may activate the gearbox mechanism **194** and determine the timing and sequence of the three successive rotational movements.

Referring to FIGS. **11**A and **11**B, the cover **130** may have an accordion-pleated shape, which allows for folding and unfolding the cover **130** along a pre-determined pattern **136**. FIG. **11**A shows three example implementations of the accordion-pleated form of the covers **130** and FIG. **11**B also shows the respective patterns of these three example forms of the cover **130**. The accordion-pleated form of the cover **130** may include a plurality of adjacent folds **136**, wherein the folds **136** may include a first fold **136***a* and a last fold **136***b*. The first fold **136***a* may be symmetrically attached to the surface of the arms **134***a* and **134***b*. During the folding of the cover **130**, each fold **136** of the cover **130** may lie on the respective adjacent fold **136** to form an accordion-pleated folded shape. The accordion-pleated form of the cover **130** may be unfolded from the folded state or folded from the unfolded state along the axis **131**.

Referring to FIG. **9**D, the gearbox mechanism **194** may be connected to the proximal ends **139***a* of the arms **134***a* or **134***b* through a connecting rod **194***g* making a pivotal connecting point **193** allowing the arms **134***a* or **134***b* to pivot around the connecting point **193**.

Referring to FIGS. **9**A and **9**B, the gearbox mechanism **194** may include: a fixed cylindrical housing **196**, attached to the movable mounting plate **162** providing a fixed base for a rotational movement, a rotatable cylindrical housing **198** rotatably mounted on the fixed cylindrical housing **196** and rotatable thereon coaxially, an input shaft **194***a* coupled with the geared motor **192** and an output shaft **194***b* attached to the proximal end **139***a* of the arms **134***a* or **134***b*, a bevel pinion-gear set **200**, configured to change the direction of power from the axis **194***d* to the axis **194***e*, a solenoid **206** attached to the upper side of the rotatable cylindrical housing **198** and rotatable therewith, and a second flat surface gear **208** attached to the solenoid **206** and placed coaxial with respect to the axis **194***d*, configured to be engaged with a first flat gear **204***b* attached to a driver bevel gear **204**.

The bevel pinion-gear set **200** may include a driven bevel pinion **202** and the driver bevel gear **204**. The driven bevel pinion **202** may be either engaged with the driver bevel gear **204** or a second flat gear **206**. The driver bevel gear **204** may be able to move up and down on an intermediate shaft **194***f*. An intermediate bevel gear set **199** may be located between the input shaft **194***a* and the intermediate shaft **194***f* configured for changing the direction of power transmission from the axis **194***c* to the axis **194***d*. The intermediate bevel gear set **199** may include a driver bevel pinion **199***a* and a driven bevel gear **199***b*. The intermediate bevel gear set **199** may be

coupled with the input shaft **194***a* receiving power from the geared motor **192** and sending power to the intermediate shaft **194***f*.

Referring to FIGS. **9**A and **9**B, the fixed cylindrical housing **196** and the rotatable cylindrical housing **198** may be considered as a housing, providing also a space for placement of the elements of the gearbox mechanism **190**. The fixed cylindrical housing **196** may have an opening, which may create a passage for the input shaft **194***a*. The fixed cylindrical housing **196** may be rotatably engaged with the rotatable cylindrical housing **198**. The fixed cylindrical housing **196** may be placed coaxial with the rotatable cylindrical housing **198**. The rotatable cylindrical housing **198** may be activated by the controller **302** to rotate in the fixed cylindrical housing **196** around the axis **194***d*. The rotatable cylindrical housing **198** may be also provided with an opening to allow the output shaft **194***b* to pass through. The output shaft **194***b* may be connected to the proximal end **139***a* of the respective arms **134***a* or **134***b*.

The driver bevel gear **204** may have a bevel surface with 45-degree geared surface **204***a* and another surface with a flat geared face **204***b*, and may be forced to move up or down on the intermediate shaft **194***f*. In another exemplary implementation the driver bevel gear **204** may have a bevel surface **204***a* and an upper flat surface, wherein the driver bevel gear **204** may be attached to the first flat gear **204***b*. The first flat gear **204***a* may be meshed with the second flat gear **208** in order to allow the rotatable cylindrical housing **198** to rotate on the fixed cylindrical housing **196**. The solenoid **206** may be coaxially attached to the rotatable cylindrical housing **196**, on which the flat surface gear **208** may be also coaxially mounted. The solenoid **206** may be configured to be activated by the controller **302** to grab the driver bevel gear **204** along the axis **194***d* on the shaft **194***f* or release the driver bevel gear **204** in order to engage or disengage the first flat gear **204***b* with the second flat gear **208**. Upon disengagement with the second flat gear **208**, the driver bevel gear **204** may be released to move down and be placed on its initial engagement with the driven bevel pinion **202**.

Upon taking the movable driver bevel gear **204** up, which may be displaceable up and down on the intermediate shaft **194***f*, the first flat gear **204***b* may be engaged with the second flat gear **208** mounted on the rotatable cylindrical housing **198**. In this state the rotatable cylindrical housing **198** may be forced to rotate around the axis **194***d* with the rotation of the second flat gear **208**. A spring may be placed on the shaft **194***f* between the solenoid **206** and the driver bevel gear **204**, providing the restoring force required for the driver bevel gear **204** to come back to its engagement position with the driven bevel pinion **202** upon releasing by the solenoid **206**. The driven pinion bevel **202** is mounted on the output shaft **194***b*, providing the required rotational movements for the respective arms **134***a* or **134***b*.

Referring to FIG. **9**C, three successive orientations of the driven bevel pinion **202** and the driver bevel gear **204** inside the gearbox mechanism **194** may cause three successive rotational movements of the arms **134***a* and **134***b*. In step **0**, the arms **134***a* and **134***b* may be in the folded state. The initial orientation of the gears inside the gearbox mechanism **194** is shown in step **0**. The first rotational movement of the arm **134***a* or **134***b* may be around the axis **103***a*. The power may be received from the geared motor **192** passing through the intermediate gear set **199** into the intermediate shaft **194***f* in order to change the direction of power. The driver bevel gear **204** may rotate accordingly with the rotation of the intermediate shaft **194***f* The driven bevel pinion **202** may also rotate subsequently in engagement with the driver bevel gear **204**, causing the arm **134***a* or **134***b* to rotate therewith. The direction and angle of rotation of the geared motor **192** may be controlled by the control system **308**. The angle of rotation of the arms **134***a* or **134***b* in each of three successive steps may be controlled to be 90 degrees. The orientations of the bevel pinion-gear set **200**, the output shaft **194***b* and the connecting rod **194***g* are shown in step **1** of FIG. **9**C. Moving on to step **2** a rotational movement of the rotatable cylindrical housing **198** on the fixed cylindrical housing **196** may be performed. The orientation of the bevel pinion-gear set **200** and the shafts **194***b* and **194***g* are shown in step **2** of FIG. **9**C. The movement of the arms **134***a* or **134***b* may be a rotation around the axis **103***b* in an appropriate direction. In order to be able to perform this rotation, upon receiving the control signal the solenoid **206** may be activated to force the driver bevel gear **204** to move up on the intermediate shaft **194***f*. The first flat gear **204***b* attached to the driver bevel gear **204** may be disengaged from the driven bevel pinion **202** and meshed with the second flat gear **208**. Upon activation by the controller **302** the power of the motor **192** from the shaft **194***f* may be received by the driver bevel gear **204** and cause the rotatable cylindrical housing **198** to rotate in an appropriate direction around the axis **194***d*. This movement may lead to the orientation of the output shaft **194***b* shown in step **2** of FIG. **9**C. Referring to FIG. **9**C, the third rotational movement of the arms **134***a* and **134***b* may be around the axis **103***c*. In this step the control system **308** may force the solenoid **206** to release the driver bevel gear **204**. The driver bevel gear **204** may be released to move down on the shaft **194***f* The spring **209** may exert a restoring force on the driver bevel gear **204** and help the driver bevel gear **204** to be engaged with the driven bevel pinion **202** again. The controller **302** may activate the geared motor **192** to rotate 90 degree in an appropriate direction. The power may be transmitted to the intermediate shaft **194***f* thereafter. Upon the rotation of the driver bevel gear **204**, the driven bevel pinion **202** may also rotate 90 degrees causing the output shaft **194***b*, and the arms **134***a* or **134***b* to rotate accordingly. This is shown as step **3** in FIG. **9**C.

Referring to FIG. **10**, a folding mechanism **210** is configured to fold or unfold the cover **306***d*. The folding mechanism **210** may be considered as an exemplary implementation of the folding mechanism of FIG. **2**. The folding mechanism **210** may include: a geared motor **212**, providing the required power for unfolding or folding of the cover **306***d*, which may be mounted on a place at the bottom of the vehicle **100** or in an enclosure other than enclosure **106**, a thin flat strip-like member **224**, for example, a strip-like spring attached to the front side of the cover **306***d* through a holder set **244** from one end, passing through a passage on a lower surface of the cover **228***a* and placed inside of a cylindrical container **214** from another end, the cylindrical container **214** configured for providing the required space for rolling the strip-like member **224**, a rubber coated roller wheel **216** coupled with the output of the geared motor **212** and rotatable therewith, making a frictional contact with the strip-like member **224** forcing the strip-like member **224** to be rolled or unrolled, a plurality of rollers **218** mounted along the path of the strip-like member **224** providing the required guiding means for the strip-like member **224** through which the strip-like member **224** may be displaced smoothly without being wrinkled, two sensors **226***a* and **226***b*, locating before and after the rubber coated roller wheel **216**, regulating the movements of the strip-like member **224** and informing the controller **302** of the beginning and finishing the unfolding or folding processes. The strip-

like member **224** may pass through the path between the roller wheel **216** and a roller **217** and move inward the container **214** or outward of the container **214**. The rollers **217** may be mounted under the strip-like member **224** in front of the roller wheel **216**, in order to facilitate the movements of the strip-like member **224**. The strip-like member **224** may be rolled in or out of the container **214**. The rolling out process of the strip-like member **224** may cause the cover **306***d* to unfold, taking place in the opening process **400** of the covering system **300**. The rolling in process of the strip-like member **224** may cause the cover **306***d* to fold, taking place in the closing process **400** of the covering system **300**.

Referring to FIGS. **10** and **12**A, the strip-like member **224** may be configured to be forced by the control system **308** to displace the cover **306***d* during the opening process **400** or the closing process **500**. The cover **306***d* may be unfolded from the initial folded position through the outward displacement of the strip-like member **224** form the container **214**. The movement of the strip-like member **224** towards the container **214** may cause the cover **306***d* to be folded from the opened position. The movements of the strip-like member **224** may be either rolling in the container **214** in the closing process **500** or rolling out of the container **214** in the opening process. As the strip-like member **224** may be attached to the end of the last fold **136***b* of the cover **306***d*, the cover may be carried with the displacement of the strip-like member **224**.

Referring to FIG. **10**, the geared motor **212** may be configured to rotate in relevant direction upon receiving an activation signal from the controller **302**. The rubber coated roller wheel **216** coupled with the geared motor **212** may rotate as well, exerting the required force on the strip-like member **224**, causing the strip-like member **224** to be taken out of the container **214**. The movement of the strip-like member **224** may be directed along the arrow **227***a* in unfolding of the cover **306***d* or arrow **227***b* shown in FIG. **10**. The strip-like member **224** may be rolled out of the container **214** as long as the contact between the roller wheel **216** and the strip-like member **224** exists and the motor **212** is making the power under the control of the controller **302**. The unrolling of the strip-like member **224** out of the container **214** may cause the cover **306***d* to take the unfolding process. Passing through the roller wheel **216**, the rollers **217** and the sensors **227***a* and **227***b*, the spring-like strip **224** may pass beneath the cover **306***d* through the passage created by the transversal cords **226** and displace the cover **306***d* frontwards.

Referring to FIGS. **11**A and **11**B, the cover **306***d* may have an accordion-pleated shape, which allows for folding and unfolding the cover **306***d* along a pre-determined pattern **136**. FIG. **11**A shows three example implementations of the accordion-pleated form of the covers **306***d* and FIG. **11**B also shows the respective patterns of these three example forms of the cover **306***d*. The accordion-pleated shape of the cover **306***d* may include a plurality of adjacent folds **136**, wherein the folds **136** may include a first fold **136***a* and a last fold **136***b*. The first fold **136***a* may be configured to be symmetrically attached to the surface of the arms **134***a* and **134***b*. During the folding of the cover **306***d*, each fold **136** of the cover **306***d* may lie on the respective adjacent fold **136** to form an accordion-pleated folded shape. The accordion-pleated form of the cover **306***d* may be unfolded from the folded state or folded from the unfolded state along the axis **131**.

Referring to FIG. **11**A, the covers **306***d* may have either a simple accordion-pleated form of folding **130***a* or different inclined accordion-pleated form of folding such as the forms shown as **130***b* and **130***c* illustrating three example implementations. The inclined forms **130***b* and **130***c* may allow the rain water not to stay on the cover **306***d* compared with the form **130***a*. In case of rain, the slope existed in the folding patterns **130***b* and **130***c* may cause the rain water to pour out due to the dip or inclination caused by the type of the folds. The cover **306***d* may be made of a fabrics **228** for the vehicle's covers and the fabric **228** may be impregnated by some type of resin that improves the folding capability of the cover and its regular opening and closing functionality without wrinkling of the folds **136**.

Referring to FIG. **12**A, the cover fabric **228** may be made of a type of material for covers having some specific properties. The fabric **228** may be selected so as to have properties like sunlight reflection, waterproofing, foldability, anti-heat, etc., wherein a kind of resin may be used as a stiffener material. The resin material can make the cover fabric **228** stiffer and improves the folding capacity of the fabric **228**.

Referring to FIG. **12**A, the cover **306***d* may include: a cover fabric **228**, having a front side, a rear side, a lower surface **228***a* and an upper surface **228***b*, which may be configured to serve as the main sheet on which a specific pattern of folding may be implemented, a plurality of flexible transversal cords **226** which may be configured to serve as supporting strings, attached to the lower surface of the cover fabric **228***a* transversely providing a supported passage **135** for the thin spring-like strip **224** to pass through and carry the cover **306***d* in the opening process or the closing process **500**, at least two longitudinal flexible cords **234**, attached to the projections caused by the adjacent folds **136** along the longitudinal line of the cover **306***d* to the lower surface of the cover **228***a* and parallel to the flat strip-like member **224** on both sides of the flat strip-like member **224** for improving the longitudinal strength of the cover **306***d* and preventing its longitudinal wrinkling, allowing the folds **136** to lie on or part from each other during the opening or closing processes **500**. The transversal cords **226** and the longitudinal cords **234** may be made of flexible materials and may be mounted on the lower surface of the cover **228***a*.

In addition some accessories may be included in order to facilitate the functionality of the cover **306***d*. Although the cover **306***d* may be operational without using the accessories, using them may boost the functionality of the cover **306***d*. For example, a thin sheet **232**, made of a material like plastic, may be attached to the lower surface of the cover fabric **228***a* having the rectangular shape. This plastic sheet **232** may increase the stiffness of the lower surface of the cover fabric **228***a*. Also a spring-like wire **236** which may be mounted within the front face of the last fold **136***b* with a very small diameter, to aid in retaining the shape of the cover **306***d* and to facilitate the opening **400** and closing **500** processes of the cover **306***d* as well as preventing the cover **306***d* from being wrinkled. Two blocks **238**, with flat shapes and heavy weights, may be mounted on both front faces of the last fold **136***b*. In some steps of the opening process **400**, the blocks **238** may facilitate the opening process **400** without wrinkling and move appropriately on the vehicle **100**, in addition to making the front of the cover **306***d* heavy and preventing the lifting of the cover **306***d* in case of severe wind. Also in some steps of the closing process **500**, blocks **238** may help correct the direction and placement of the holding clamps **240** on the appendages of the arm **242***a* and **242***b*. At least two movable guiding devices **240** may

facilitate the carrying of the cover **306***d* during the opening **400** or closing **500** processes.

The thin plastic sheet **232** may be utilized to enhance the cover strength and durability besides improving the foldability of the cover **306***d*. The transversal cords **226** may be made of cotton and additional materials with similar properties as cotton having the flexibility and other properties. The transversal cords **226** may be attached to the projections by the adjacent folds **136** at regular distances at the lower surface of the cover fabric **228***a*. The transversal cords **226** may provide a passage for the thin flat spring-like strip **224** to pass through and enhance the opening **400** and closing **500** processes of the cover **306***d* and prevent disorganization of the folds **136** and wrinkling.

Referring to FIG. **12**B, at least two movable guiding devices **240** may be used to hold the cover **306***d* at a correct level and facilitate the movement of the cover **306***d* thereafter, during the opening **400** and closing **500** processes. An example implementation of the movable guiding devices is shown in FIG. **12**B. Each of the movable guiding devices **236**, which may be mounted on the lower inside side of the last fold **136***b*, may include a wheel **240***b* and a clamp **240***a*. The wheel may be rolled on the ground in the opening **400** or closing **500** processes. The roller wheels **236***b* along with the clamps **240***a* may be configured to hold and facilitate the movement of the cover **306***d*. Also the roller wheels **240***b* may be used to guide the cover **306***d* to be correctly placed on the appendages **242***a* and **242***b* of the arms **134***a* and **134***b* when the cover **306***d* is the closing process **500**. The roller wheels **240***b* may be placed on the appendages of the arms **242***a* and **242***b*, at the final step of the folding process of the cover **306***d*.

FIG. **12**B also shows an exemplary implementation of a holder set **244**, which may be configured to provide the required means for connecting the strip-like member **224** to the front side of the lower surface of the cover fabric **228**. Referring to FIG. **12**B, the holder set **244** may include an L-shaped holder **244***a* having a slot **244***c* in the bending junction line of the L-shaped holder **244***a*, and a rubber-coated roller wheel **244***b*, mounted on the slot **244***c*. The holder set **244** may be mounted at the front side of the lower surface **228***a* the cover **306***d* through attaching the L-shaped holder **244***a* to the cover **306***d*, and configured to facilitate the attachment of the strip-like member **224** thereon. The roller wheel **244***b* attached to the L-shaped holder **244***a* may facilitate the smooth movement of the strip-like member **224** and hence, the folding or unfolding of the cover **306***d* over the outer surface of the vehicle **100**. Roller wheel **244***b* may be in contact with the surface of the vehicle **100** during the opening **400** or closing **500** processes. Therefore, roller wheel **244***b* it may also prevent the cover **306***d* from putting scratch marks on the body of the vehicle **100**.

Referring to FIG. **12**A, the strip-like member **224**, which may be coated with a layer of protecting material like rubber, may be actuated in the folding mechanism **210** by the control system **308** to cause the cover **306***d* to undertake the folding or unfolding processes. Passing through the passage made by the flexible transversal cords **226**, the strip-like member **224** may carry the cover **306***d* during the opening process **400** towards the front side of the vehicle **100** or during the closing process **500** towards the back side of the vehicle **100**.

Referring to FIGS. **12**A and **12**B, a roller **246***a* may be mounted on the line along which the strip-like member **224** may be bent in order to change its direction from the container **214** to the final position. The strip-like member **224** may be rolled out of the container **214** horizontally, and makes its way towards the location at the front side of the vehicle **100**. Therefore, it may need to change its direction in a place wherein the roller **246***a* may be mounted. This roller **246***a* may be mounted parallel to the rollers **218** and **217** shown in FIG. **10**, facilitating the inward or outward displacements of the strip-like member **224** to be smooth and without wrinkling.

Referring to FIGS. **12**A and **13**, the spring-like wire **236** may be attached to an outer face of the last fold **136***b*, which allow the cover **306***d* to appropriately open or close. Also, the spring-like wire **236** may help prevent the transverse wrinkling of the folds. Two blocks **238** may be mounted at either sides of the last fold **136***b*, in order to prevent the cover **306***d* from being displaced due to the outside effects. Also at least two sets of the roller wheels **240***b* may be placed on a holding clamp **240***a*, which may allow the cover **306***d* to properly move. The arrow **245** shows the direction of movement of the wheel **240***b* and the displacement of the cover **306***d* in the closing process **500**. When the wheel **240***b* reaches the respective arm **242***b*. This placement may cause the wheels **240***b* to be disconnected from the ground and prevent the displacing of the wheels **240***b* on the ground in this stage, making the cover **306***d* and the arms **134***a* and **134***b* in the opened state ready to be closed to the folded position.

Referring to FIG. **14**, as the cover **306***d* fully unfolds, shown in the first figure, and wraps the entire surface of the vehicle **100**, movement of the cover **306***d* may be stopped by the controller **302**. Movement of the cover **306***d* in the opening process **400** may occur due to the outward movement of the strip-like member **224** from the container **214** from the backside of the vehicle **100** to the front side of the vehicle **100**. Once, cover **306***d* is fully open, the control system **308** may cause the speaker **114** to stop playing the alarm and the vehicle's flashers **108** to be turned off. The control system **308** may be hold in the standby mode, waiting for the next operation to be summoned. It may be possible for user to trigger the cover **306***d* to be rolled up by applying the respective command of closing the cover **306***d* through the remote control **301**.

Referring to FIG. **14**, upon receiving the control command for folding of the cover **306***d* from the remote control **301**, the controller **302** may utilize the distance sensors **122** to determine if the required distance of the rear bumper **102** from the sides are in the allowable range for folding of cover **306***d*. Right after receiving the respective authorizing command, the flashers **108** may be turned on and a warning alarm may be played through the speaker **114**. The procedures which may have been performed in order to get open the cover **306***d*, may be carried out in a successive reverse order of steps as compared to the opening steps. The control system **308** may activate the folding mechanism **210** to actuate the strip-like member **224** to be rolled up. The motor **212** may be forced to rotate in a reverse direction compared with the unfolding process causing the roller wheel **216** to rotate therewith in a reverse direction compared with the opening process **400**. The strip-like member **224** may be forced to displace along the arrow **227***b*, shown in FIG. **10**, passing through the sensor **226***a* and a plurality of the rollers **218**, before making the way towards the path through the roller wheel **216** and the beneath roller **217**, in order to be rolled up in the container **214**.

Referring to FIGS. **10**, **14** and **15**A, as a result of displacement of the strip-like member **224** along the arrow **227***b*, the cover **306***d* may be displaced along the arrow **240***c*. The cover **306***d* may begin to uncover the outer surface of the vehicle **100** smoothly and continuously, shown in the second figure of FIG. **14**. The wheels **240***b* may

be forced to displace the direction of the arrow **245** till reaching the respective appendage **242***a* or **242***b*. In this state the wheels **240***b* may be placed on the appendages **242***a* or **242***b* in order to facilitate the closing of the arms **134***a* and **134***b*, thereafter. The cover **306***d* may displace along a path, which may be nonlinear in portions shown by **247***a* and **247***b* and linear in another portion **245** between two nonlinear portions **247***a* and **247***a*. The arrow **245** also shows the direction of the entire path of the wheel **240***b*. During the folding process, the cover **306***d* may displace along this arrow. The folding of the cover **306***d* may be performed utilizing curved paths, the nonlinear sections of the path are illustrated by **247***a* and **247***b*, when displacing over the front and rear sections of the vehicle **100**. Passing over the intermediate section of the vehicle **100** may be also performed in the linear path **245**. After going past regions referenced as **247***a*, **245** and **247***b*, the cover **306***d* may take the folded position placed on the arms **134***a* and **134***b* in their opened states taking the U-shaped form shown by **241** in FIG. **15**A.

Referring to FIGS. **15**A and **16**, after the cover **306***d* folds and the wheels **240***b* are placed on the respective appendages **242***a* and **242***b* as shown in the first illustration of FIG. **15**A, the arms **134***a* and **134***b* may undergo the closing operation as shown in the second illustration of FIG. **15**A and first of the FIG. **15**B. The closing of the arms **134***a* and **134***b* may be performed from the opened state to the closed state in a set of one or three successive pivotally rotational movements. Thereafter, the cover **306***d* and the arms **134***a* and **134***b* may take the closed shape as shown in FIG. **15**B as the state **15***d* and in FIG. **16** as the state **243**. In the vehicles **100** having a trunk **104**, i.e. sedan-type vehicles, the closing process **500** of the arms **134***a* and **134***b* from either sides of the vehicle **100**, in the U-shaped position along with the cover **100** shown in first illustration of FIG. **15**A, to the position **243** of FIG. **16**, parallel to the rear bumper **102** and the ground, may include a rotational movement of the arms **134***a* and **134***b* around the respective pivot line **181***a* or **181***b* making from the connecting line of the arms **134***a* and **134***b* to the opening/closing mechanism **303***c* shown in FIG. **6**. This rotational movement may be performed in the same way as the opening process **400** but in a reverse a reverse direction of rotation compared with the arrows **183***a* or **183***b* of the opening process **400** shown in FIG. **6**.

Referring to FIGS. **6**A and **8**A, the opening/closing mechanism **303***c* may be responsible for rotationally displacing the arms **134***a* and **134***b*, in sedan types of the vehicles **100**A. First the control system **308** may force the motor **184***a* or **184***b* to rotate and cause the arms **134***a* and **134**Bb to rotate accordingly. Rotating in an opposite direction to the rotation of the opening process **400**, shown as arrow **183***a* or **183***b*, the motor **184***a* or **184***b* may force the central axis **189***a* or **189***b* of the hinge **188***a* or **188***b* to rotate accordingly. Thereafter the upper leaf **195***a* or **195***b* also may rotate and cause the arms **134***a* or **134***b* to rotate accordingly. The sensors **186***a* and **186***b* for sensing the rotation movements may regulate the allowable amount of the rotational movement of the arms **134***a* and **134***b*, through controlling the rotation of the motor **184**A and **184**B.

Referring to FIG. **15**B, for the vehicles **100** without a specific trunk section **104**, the closing of the arms **134***a* and **134***b* from their positions on either sides of the vehicle **100**, to the position, shown in FIG. **16** as **243**, parallel to the rear bumper **102** and the ground, may include three successive rotational movements. The coordinate system are the same as the coordinate system defined in FIG. **7**B. The arms **134***a* and **134***b* may rotate about the axes **103***c*, **103***b*, **103***a* respectively (the reverse sequence compared with the opening process **400**) passing through the origin marked as **103***o*. The origin **103***o* may be the pivotal connecting point **193** of the arms **134***a* and **134***b* with the output shaft **194***b* of the gearbox mechanism **194** shown in FIG. **9**B (connecting point of the rod **194***g* to the shaft **194***b* shown as **193** which exist for each of the arms **134***a* and **134***b*). The direction of the rotations in the closing process **500** may be opposite to the directions in the opening process **400** shown in FIG. **7**B as **103***d*, **103***e* and **103***f*. In the step **15***a*, the arms **134***a* or **134***b* in the opened state may rotate around the respective axis **103***c* or **103***c*' in the directions opposite to the directions shown by arrows **103***f*. The arms **134***a* and **134***b* may displace from their initial positions on either sides of the vehicle **100***b* to the positions parallel to the axes **103***a* or **103***a*'. Then in the step **15***b* the rotations may be around the axes **103***b* and **103***a* and in the opposite directions compared with the directions of the **103***e* and **103***d* arrows for the arm **134***a*, and around the axes **103***b*' and **103***a*' and in the opposite directions to the **103***e*' and **103***d*' for the arm **134***b*. Each of these steps are shown as **15***a*, **15***b*, **15***c* and **15***d* states successively in FIG. **15**B. The orientation of the arms **134***a* and **134***b* in each step are marked as **241***a* in the state **15***a*, **241***b* in the state **15***b*, **241***c* in the state **15***c* and **243** in the step **15***d*. After undergoing these successive rotational movements, the arms **134***a* and **134***b* may be located in the folded form parallel to the back of the rear bumper **102** ready to be taken inside of the enclosure **106**.

Referring to FIGS. **9**B and **9**D, the motor **192** may be triggered by the controller **302** to rotate in an opposite direction compared with the opening process **400** and the gearbox mechanism **194** may be forced to deliver the required rotation accordingly. The three rotational movements may be performed through the direction changes of the power transmission. In each rotation of the gearbox mechanism **194**, the arms **134***a* or **134***b* may also rotate in order to reach the final position.

Referring to FIG. **16**, after folding the cover **306***d* and closing the arms **134***a* and **134***b*, the folded cover and arms **306***b* may be placed parallel to the rear bumper **102** and the ground in the position **243** shown in FIG. **16**. Right after, the folded cover and arms **306***b* may be forced to come inside of the enclosure **106**. The moveable wall of the rear bumper **306***a* may be remained still open under the bottom **128** of the vehicle **100**. The control system **308** may activate the second actuating mechanism **160** to take the folded cover and arms **306***b* in the enclosure **106**, which may be performed along the arrow **16***e*. In the step **16***a*, the folded cover and arms **306***b* may be placed parallel to the rear bumper **102** and the ground. In the step **16***b* the folded cover and arms **306***b* may be taken inside the enclosure **106** but the rear bumper **102** is remained open.

Referring to FIGS. **16** and **6**A, the second actuating mechanism **160** may be activated in a reverse sequence compared with the taking out process. It means that the controller **302** may activate the motor **166** to rotate in a reverse direction. Then the rotational movement of the motor **166** may be converted to the linear movement by the converting mechanism **167** in a reverse direction compared with the taking in process. Then the movable mounting plate **162** may be linearly taken in the enclosure **106** as a result of receiving the linear movement from the converting mechanism **167**. In one example implementation, the converting mechanism **167** may include the pinion **170** and the rack gear **168**. The pinion **170** may be rotatably coupled with the motor **166**, causing the rack gear **168**, which may be meshed with the pinion **170** and attached to the movable mounting

plate **162**, to be linearly displaced inwards. The arms **134***a* and **134***b* may be attached to the opening/closing mechanism **303***c* or **190** and the opening/closing mechanism **303***c* or **190** may be also mounted on the movable mounting plate **162**. The linear inward movement of the movable mounting plate **162** may cause the folded cover and arms **306***b* to be taken in the enclosure **106**. The opening/closing mechanism **303***c* or **190** may be also taken inside. The sequence of this operation may be controlled by the control system **308**. The sensor **172***b* may sense the movement of the movable mounting plate **162** and regulate the end of the operation in association with the control system **308**. When the folded cover and arms **306***b* is placed fully inside the enclosure **106**, the sensor **172***b* may inform the control system **308** to take the relevant next control operation.

Referring to FIGS. **16** and **5**, after taking the folded cover and arms **306***b* in the enclosure **106**, the first displacing mechanism **303***a* may be activated by the controller **302** to displace the moveable wall of the rear bumper **306***a* to its initial place on the rear bumper **102**. The positions marked as **16***c* and **16***d* in FIG. **16** are related to the movements of the moveable wall of the rear bumper **306***a*. The control system **308** may activate the rotary actuator **142** to rotate in an opposite direction to the direction of the opening process **400**, causing the converting mechanism **144** to convert the rotational movement of the motor **142***a* to the linear movement of the intermediate link **146**. The converting mechanism **144** may include the threaded rod **144***a* and the nut **144***b* in one example implementation or a ball screw assembly in another example implementation. The converting mechanism **144** may force the intermediate link **146** to move in a reverse direction compared with the opening process **400**, in a linear outward direction on the rails **150**. As a result the movable wall of the rear bumper **306***a*, attached to the intermediate link **146** by the hinge **148** and the spring **149**, may be pushed toward the bumper **102**. The hinge **148** and its accompanied spring **149**, may receive the linear movement of the intermediate link **146** and transmit the displacement in a way to force the moveable wall of the rear bumper **306***a* to be displaced toward the initial place on the bumper **102**. The movements of the moveable wall of the rear bumper **306***a* are marked as **16***c* and **14***d*, in FIG. **16**. After being placed on the rear bumper **102**, the magnetic lock **115** which is, in one example implementation, embedded on the rear bumper **102** and the movable wall **306***a*, may be triggered by the control system **308** to take the locking operation, and the process of the closing may be finished. The control system **308** may control the sequence of this operation. The sensors **152** may inform the controller **302** of the full placement of the movable wall of the rear bumper **306***a* on the bumper **102** in order to make the next control decision.

FIGS. **18**A and **18**B show exemplary covering processes associated with the covering system **300**. FIG. **18**A shows the opening process **400** of the covering system **300** and FIG. **18**B shows the closing process **500** of the covering system **300**. The flowcharts show the sequence of the opening **400** process and closing process **500** of the cover **306***d*. In step **402**, the covering system **300**, a mode of operation may be determined. A user may set the operation process to an automatically triggered mode or a manually triggered mode. The sequence of the manually triggered mode is shown by arrow **401** and the sequence of the automatically triggered mode is shown by arrow **403**. In the manually triggered mode, a user may decide whether there is a need for the covering system **300** to be activated. In one exemplary implementation, upon deciding that a cover is needed, a user may use the remote control **302** to activate the following procedures. In step **409**, of the automatically triggered mode of the opening process **400**, the sensor system **304** through the inside sensing system **304***a* may determine the need for the opening process **400** of the covering system **300** which is activated when certain environmental conditions are detected including sunlight, temperature, and humidity. Referring to FIGS. **1** and **2**, in one example implementation, the outside sensing system **304***a* may include the light sensor **120**, the temperature sensor **111**, and the humidity sensor **113**, respectively configured to sense the sunlight, temperature and humidity. The controller **302** may decide the necessity of activation of the covering system **300**. The opening process **400**, then, undergoes the same sequence of actuations as the manually triggered mode.

In step **404**, the distance of the vehicle **100** from adjacent walls or barriers of parking location may be determined. The distance may be checked to determine whether it is bigger than a predefined value, the value representing a distance needed for proper operation of an exemplary covering system. The distance may be sensed by the distance sensor **122**. Referring to FIG. **1**, in one example implementation, the distance sensor **122** may be placed on the rear bumper **102** in order to detect the distance of the rear bumper **102** to the barriers. Then the information may be sent to the controller **302**. The controller **302** may determine if the distance meets the minimum defined threshold value. The minimum distance is the distance required for the folded cover and arms **306***b* to be taken out of the enclosure **106** and opened without collision. If the distance requirement is satisfied, the exemplary process may proceed to step **406**. In the step **406** the first displacing mechanism **303***a* may be activated to displace the movable wall of the rear bumper **306***a*. In one example implementation the first position may be on the rear bumper **102** and the second position may be under the bottom surface of the vehicle **128**. The displacing of the movable wall of the rear bumper **306***a* may be performed after the opening of a locking mechanism **115** embedded on the movable wall of the rear bumper **306***a*, which may be done by the control system **308**, in one exemplary implementation of the present disclosure. The displacement of the movable wall of the rear bumper **306***a* may be from the first position to the second position in the opening process **400** shown in FIG. **4**A, and from the second position to the first position in the closing process **500** of the covering system **300** shown in FIG. **4**A.

Moving on to the next step **408**, the controller **302** may activate the second displacing mechanism **303***b* in order to take the folded cover and arms **306***b* out of the first position to the second position. The first position may be inside the enclosure **106** and the second position may be parallel to the rear bumper **102** and the ground in one example implementation. In the folding process of the covering system **300** the folded cover and arms **306***b* may be taken inside the first position from the second position by the second displacing mechanism **303***b*. The controller **302** may decide the timing of the displacement of the folded cover and arms **306***b*. The opening/closing mechanism **303***c* may be also taken in or out of the enclosure **106** along with the folded cover and arms **306***b*. As a result the folded cover and arms **306***b* may be placed in the defined position ready to undergo the opening process **400** or the closing process **500** of the closed arms **134***a* and **134***b*. Moving to the next step **410** the opening/closing mechanism **303***c* may be activated by the controller **302**. The opening/closing mechanism **303***c* may cause the arms **134***a* and **134***b* to move from the closed

position to the opened position by a rotational movement or a set of three successive rotational movements in two different example implementations of the current disclosure for two different types of the vehicles **100**, which is further described formerly in this disclosure. The closed position of the arms **134***a* and **134***b* may be the same as the second position of the previous step **408** and the opened position may be at either sides of the vehicle **100** parallel to the sides of the vehicle **100** and the ground. As a result the arms **134***a* and **134***b* may be placed in the positions which allows the unfolding process of the covering system **300** to be performed.

In step **412**, the folding mechanism **303***d* may be activated by the control system **308** in order to unfold the cover **306***d* from the opened position of the step **410**, i.e., the position in which the arms **134**A and **134**B may be parallel to either sides of the vehicle **100** and the ground, to a final position or fold the cover **306***d* from the final position to the opened position of the previous step **410**. The unfolding process may be performed in the opening process **400** of the covering system **300** and the folding process may be performed in the closing process **500** of the covering system **300**.

Referring to FIG. **18**B, the closing process **500** of the covering system **300** may be carried out sequentially. The closing process **500** of the covering system **300** may be triggered by a user using the remote control **301**. The steps of the closing process **500** are similar to the opening process **400** but performed in a reverse order, which is described in further detail throughout the present disclosure. The closing process **500** may begin by a user pressing a respective tab on the remote control **301**, which is shown as step **502**. After sending the uncovering command to the controller **302**, the folding mechanism **303***d* may be activated by the controller **302** in the step **504**. The folding mechanism **303***d* may actuate the cover **306***d* to take the folding operation from the unfolded position to the folded position on the opened arms **134***a* and **134***b*. As a result the cover **306***d* may be placed on the arms **134***a* and **134***b* in a folded state of the cover **306***d* wherein the arms **134***a* and **134***b* may be parallel to the sides of the vehicle **100** and the ground. In step **506**, the opening/closing mechanism **303***c* may be activated by the controller **302** to actuate the arms **134***a* and **134***b* to be closed. The arms **134***a* and **134***b* may undergo the closing operation from the opened position to the closed positions of the arms **134***a* and **134***b* in either a pivotally rotational movement or a set of three pivotally rotational movements in the reverse direction compared with the opening process **400**. As a result the arms **134***a* and **134***b* may be placed parallel to the rear bumper **102** and the ground, which is further described formerly in this disclosure. Moving on to the next step **508**, the second displacing mechanism **303***b*, may be activated by the controller **302** to take the folded cover and arms **306***b* inside the enclosure **106**. Moving on to the next step **510**, the first displacing mechanism **303***a* may be activated by the controller **302** to displace the wall of the rear bumper **306***a* from the second position to the first position on the rear bumper **102**.

What is claimed is:

1. A vehicle covering system, comprising:

a cover, the cover comprising:

a cover fabric comprising a plurality of folds in an accordion-pleated shape, an upper surface, and a lower surface;

a plurality of transversal cords attached to the lower surface of the cover fabric providing a guiding passage for a strip-like member to pass on the lower surface of the cover fabric; and

at least two longitudinal cords, wherein the longitudinal cords are symmetrically attached to the lower surface of the cover fabric at either sides of the strip-like member;

a first arm and a second arm, a first portion of a first fold of the plurality of folds attached to an upper surface of the first arm and a second portion of the first fold attached to an upper surface of the second arm,

an arms mechanism, configured to place the first and the second arms in respective opened and closed states, the respective opened and closed states being perpendicular to each other;

a folding mechanism, configured to fold and unfold the cover across a length of a vehicle;

a control system, configured to actuate the arm mechanism to open the first arm and the second arm from a closed state to an opened state and cause the arm mechanism to close the first arm and the second arm from the opened state to a closed state, and actuate the folding mechanism to fold and unfold the cover when the first and the second arms are in respective opened states; and

an enclosure inside the rear section of the vehicle to enclose the cover, the first and the second arms, and the arm mechanism, wherein the rear section includes a part of the trunk and the hollow space inside a rear bumper.

2. The covering system according to claim **1**, wherein the rear bumper includes a movable wall configured to be displaced from a first position to a second position, wherein the first location is on the rear bumper and the second location is under the vehicle.

3. The covering system according to claim **1**, further comprising a first displacing mechanism configured to move a movable wall of the rear bumper from a first position to a second position, wherein the first displacing mechanism comprises:

a rotary actuator with an output shaft;

a converting mechanism coupled with the output shaft; and

an intermediate link attached to the movable wall of the rear bumper from one side and engaged with the converting mechanism from the other side,

wherein the converting mechanism is configured to convert the rotational movement of the output shaft to a linear movement of the intermediate link.

4. The covering system according to claim **1**, further comprising a second displacing mechanism disposed within the enclosure, configured to displace the cover in a folded state, the arms and the arm mechanism, wherein the second displacing mechanism comprises:

a movable mounting plate, configured to allow for mounting the arm mechanism thereon; and

an actuating mechanism coupled with the movable mounting plate, configured to displace the movable mounting plate in and out of the enclosure.

5. The covering system according to claim **4**, wherein the actuating mechanism comprises:

a motor having an output shaft;

a converting mechanism coupled with the output shaft; and

wherein the converting mechanism is configured to convert the rotational movement of the output shaft to a linear movement of the movable mounting plate.

6. The covering system according to claim **1**, wherein the arm mechanism includes:

a first actuating mechanism pivotally coupled to a proximal end of the first arm, configured to actuate the first arm to pivot about a first pivot point from a closed state to an opened state in an opening process and to pivot about the first pivot point from the opened state to the closed state in a closing process; and

a second actuating mechanism pivotally coupled to a proximal end of the second arm, configured to actuate the second arm to pivot about a second pivot point from a closed state to an opened state in an opening process and to pivot about the second pivot point from the opened state to the closed state in a closing process.

7. The covering system according to claim **6**, wherein the closed state is defined as a state of the arms parallel to the backside of the vehicle and ground.

8. The covering system according to claim **6**, wherein the opened state is perpendicular to the ground.

9. The covering system according to claim **6**, wherein the first actuating mechanism and the second actuating mechanism comprises:

a hinge device having an upper leaf and a lower leaf and a central axis, wherein the lower leaf is fixed on the movable mounting plate, the upper leaf is attached to a respective arm,

a motor coupled with the central axis, the motor configured to rotate the respective arm.

10. The covering system according to claim **9**, wherein the first actuating mechanism and the second actuating mechanism comprises:

a gearbox mechanism attached to the moveable mounting plate having an input shaft coupled with the motor and an output shaft pivotally attached to the proximal end of one of the arms, wherein the gearbox mechanism comprises:

a housing, wherein the housing comprises a fixed cylindrical container mounted on the movable mounting plate and fixed thereon configured to linearly displace therewith, and a rotatable cylindrical housing mounted coaxially on the fixed cylindrical container;

a bevel pinion-gear set, configured to rotate the respective arm, including a driver bevel gear mounted on the input shaft and coupled with the motor and meshed with a driven bevel pinion configured to transmit the rotational power of the motor to the driven bevel pinion and freely displace along a shaft and a driven bevel pinion mounted on the output shaft and attached pivotally to the proximal end of the respective arm, wherein the driven bevel pinion is configured to transmit the rotational power to the respective arm;

a first flat gear coaxially attached to the upper surface of the driver bevel gear and rotatable therewith; and

a solenoid attached to the upper section of the rotatable cylindrical container, wherein the solenoid is configured to engage and disengage the first flat gear with a second flat gear,

wherein the second flat gear is attached to the solenoid coaxial with the first flat gear.

11. The covering system according to claim **1**, wherein the folding mechanism includes:

a container;

a strip-like member placed inside the container from one end and attached to a last fold of the plurality of folds; and

an actuator, configured to roll the strip-like member in and out of the container.

12. The covering system according to claim **11**, wherein the actuator includes:

a motor configured to drive the strip-like spring in and out of the container;

a roller wheel coupled with the motor transversely placed on the strip-like member forcing the strip-like member to move in a direct path;

a plurality of the rollers, placed on the strip-like member to straighten the path of the strip-like member.

13. The covering system according to claim **12**, wherein the strip-like member of the folding mechanism is symmetrically attached to the last fold of the cover passing through the passage made by the transversal cords on the lower surface of the cover carrying the cover to be unfolded or folded.

14. The covering system according to claim **1**, wherein two equal lengths of either sides of the first fold of the cover are attached to the upper surfaces of the first arm and the second arm.

15. The covering system according to claim **1**, wherein the control system is configured to cause the second displacing mechanism to displace the arm mechanism, the first and the second arms, and the cover in and out of the enclosure when the first and the second arms are in the closed position.

16. A method for managing a covering system, wherein the method for opening comprises:

sensing the environmental conditions for the covering system utilizing environmental data received from sensors;

determining a need for activation of the covering system by a controller based on the environmental conditions;

checking distance of a vehicle to barriers of a parking location responsive to a determination that activation of the covering system is needed;

activating a first displacing mechanism for displacing a movable wall of a rear bumper from an initial location on a rear bumper to a secondary location;

activating a second displacing mechanism for taking a folded cover and arms along with an arm mechanism out of a first enclosure to a second position parallel to the rear bumper and ground;

activating the arm mechanism for opening closed arms from a closed state of the second position to an opened state of a third position; and

activating a folding mechanism for unfolding a cover from a folded state in the third position to an unfolded state in a fourth position.

17. The method according to claim **16**, wherein the positions include:

the second position, wherein a folded cover and arms is placed parallel to the rear bumper and the ground;

the third position, wherein the arms are opened and placed perpendicular to the ground; and

the fourth position, wherein the cover is unfolded.

18. The method according to claim **17**, wherein the method for closing includes:

receiving an uncovering command by the controller from a remote control;

activating the folding mechanism for folding the cover from an unfolded state of the fourth position to a folded state in the third position;

activating the arm mechanism for closing the arms from the opened state in the third position to the closed state in the second position;

activating the second displacing mechanism for taking the folded cover and arms along with the arm mechanism inside the first enclosure from the second position; and

activating the first displacing mechanism for displacing the movable wall of the rear bumper to the initial location on the rear bumper.

19. The covering system according to claim **1**, wherein the length of the car extends from the rear bumper to a front bumper.

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